federal register

FRIDAY, MAY 20, 1977

PART VII

# FEDERAL COMMUNICATIONS COMMISSION

■

## LAND MOBILE SERVICES

### Inquiry Into Practices and Procedures for Spectrum Management

## FEDERAL COMMUNICATIONS COMMISSION

[47 CFR 89, 91, 93]

[Docket No. 21229; FCC 77-287]

### LAND MOBILE SERVICES

**Practices and Procedures for Spectrum Management Governed by Parts 89, 91, 93 of the Commission's Rules; Notice of Inquiry**

AGENCY: Federal Communications Commission.

ACTION: Notice of Inquiry, Request for Comments.

SUMMARY: The Commission is seeking public response to its plan for developing a new program of spectrum management for the land mobile radio services. These services include most private uses of two way radio and radio paging by police, fire, business, and other industrial users. The Commission invites comments on a new aplication form that will be used to build a computerized data base. The Commission also announces its intention to develop new rules and standards for the selection of requencies for land mobile systems. Also included is a report on spectrum monitoring that the Commission has been conducting in Chicago on a trial basis. Public response to any of the material presented will be considered in the development of the new program.

DATES: Comments must be received on or before July 15, 1977, and Reply Comments must be received on or before August 15, 1977.

ADDRESS: Federal Communications Commission, Washington, D.C. 20554.

FOR FURTHER INFORMATION CONTACT:

Morgan O'Brien, Safety and Special Radio Services Bureau, Federal Communications Commission, Washington, D.C. 20554 (202-254-3301).

SUPPLEMENTARY INFORMATION:

Adopted: April 27, 1977

Released: May 17, 1977

1. The Federal Communications Commission hereby gives notice of an inquiry into practices and procedures for more comprehensive management of the land mobile services. The Commission has developed a new program of spectrum management of the land mobile services with the following immediate objectives:

a. A nationwide data base of all land mobile systems, computerized to permit access by the Commission, the land mobile community, and the general public. The Commission has set forth herein the data elements of the proposed data base. It requests comments on these and on several alternate data base designs.

b. Rules and standards for private frequency coordinators, to be formulated in a proceeding that will be initiated within the next several months. In conjunction with the development of rules and standards, the Commission will establish a program to audit the performance of the coordinators.

c. Monitoring to collect channel utilization statistics for areas of severe congestion. Comments are invited on formats for presenting utilization information to the land mobile users, coordinators and vendors. Representative formats have been included and comments are invited.

d. Relaxation of radio service block allocations to permit wider sharing of frequencies in Chicago on a trial basis.

2. These objectives are the result of extensive staff study, and are based on several years of experience with the Chicago pilot. The declaration of specific objectives is not intended to foreclose comments suggesting modifications to the new program. It is intended to present a clear picture of the Commission's present intentions. Interested parties are encouraged to take issue with all or any part of the program. The resources presently available to the Commission for the land mobile services, and those that become available over the next several years, will be committed to achieving the objectives that are finally resolved by the Commission after careful consideration of the comments received in this proceeding.

#### INTRODUCTION

3. This Notice begins the second stage of the Commission's program for improved management of the land mobile spectrum. The first stage was initiated formally in 1971 with the issuance of a proposed rulemaking in Docket 19150. (Notice of Proposed Rule Making, Docket (No. 19150, 27 FCC2D 400 (1971)). First Report and Order, Docket No. 19150, 32 FCC2D 347 (1971). Second Report and Order, Docket No. 19150, 38 FCC2D 625 (1972). There were numerous antecedents to that proceeding, particularly the work of the Advisory Committee for the Land Mobile Radio Services (ACLMRS) and the Joint Technical Advisory Committee (JTAC). (See Report of the ACLMRS, Vol. I, Vol. II, Parts 1 and 2, July, 1968. See Spectrum Engineering, The Key to Progress, New York, 1968.) Under contract to the FCC, Stanford Research Institute designed the basic elements of a spectrum management pilot program in the late 1960's. In 1972 the Commission established an office in Chicago to test the spectrum management techniques that had been proposed. The elements of the experiment were a computerized data base of all land mobile equipment operating in the Chicago region; a staff of experts located regionally to handle frequency selection and licensing of new systems; a mobile monitoring program to collect channel utilization statistics; and proposed changes to the block allocation system to increase the sharing of frequencies between radio services. The Chicago experience has been detailed extensively in published reports. (See Report on Restructuring The Spectrum Management Task Force, (1975), W. Sutter. Analysis and Recommendations Concerning Regional Spectrum Management, D. Hatfield, FCC Report No. 76-606. Chronology of the National Spectrum Management Program (1976), FCC Report No. SMTF 76-01.)

4. Major revisions to the program of regionalization envisioned in Docket 19150 were approved by the Commission in June of 1976. (See Analysis and Recommendations Concerning Regional Spectrum Management, D. Hatfield.) The Commission based these changes not only on the experience in Chicago, but also on a reconsideration of the nationwide requirements of the land mobile services. A vital element of this reconsideration was the finding that the total cost of a fully regionalized system, as originally proposed in Docket 19150, does not appear to be justified by the benefits to be anticipated. All FCC programs are being subjected to this scrutiny in light of the current budget situation. This finding, of course, cannot overshadow the fact that congestion in the land mobile services, aggravated by manual systems for frequency selection and licensing, continues to plague the users of these frequencies and continues to require innovative responses from the Commission.

5. The Commission therefore has decided to develop a revised program of spectrum management, based on those elements of the Chicago experiment that have demonstrated their utility. This is to be a program that maintains a favorable balance between the costs incurred and the beneficial effects that can reasonably be expected. Immediate steps have been taken to reduce the costs involved in the program, including a significant reduction in staffing level and relocation of the Chicago computer to Washington where it will be shared ultimately by other Commission offices. Substantial reductions in the scope of the monitoring program have been made and further changes in the Chicago monitoring program are contemplated, as described more fully in Section III.

6. All plans for additional regional facilities have been deferred. The costs now being incurred have been reduced to those covering personnel sufficient to design a nationwide system and a small staff remaining in Chicago to continue monitoring operations and public interface. In the design of the new system each cost element of the proposed program will be analyzed and alternatives will be considered based on the ratio of cost to benefits. The major components in this regard are the nationwide data base and the monitoring program. A cost analysis of the alternatives developed after consideration of the comments filed in this proceeding will be made a part of the record of this proceeding.

7. The text of the Notice conforms to the objectives stated in paragraph one. Section I deals with the elements we propose to include in the Nationwide data base raises questions that must be considered in the design of the computerized system. Section II covers the issue of frequency recommendations by the private frequency coordinators; it lists the engineering models developed in Chicago that will be available for analysis of congestion problems and for audit-

ing the performance of the coordinators. Section III reports briefly on the current plans for monitoring in Chicago. It also serves as an introduction to Appendix B which reports the current status of analysis of monitoring data. Section IV summarizes the Commission's findings with regard to the possibility of wider sharing of frequencies and proposes several definitions that will lay the groundwork for later sharing proposals.

### I. The License Data Base

8. On a centralized, nationwide basis, the Commission's present manual processing system and the current method of computer input, storage and retrieval of land mobile information is seriously inadequate for effective frequency managing, rulemaking, research, reporting and providing public assistance. These inadequacies are due primarily to the inability to readily access the information. The ability to retrieve information from the data base and a means for the staff to easily make changes in the records of the data base are two of the key features of the automated licensing system which has been in operation in Chicago for the past three years.

9. There are a number of ways to access information in a data base. We have experimented with many methods (software and hardware) to access the Chicago data base. The types of information and its retrieval required by parties outside the Commission is important in the final design of an automated national data base system. There are questions which need to be answered as soon as possible, such as, how will the data be furnished to these outside parties, and what information will be required? Before asking for specific comments, we would like to apprise the public of the various possibilities.

10. Much of our presentation and many of the solicited comments will be directed to the information contained in Appendix A. This Appendix lists the proposed elements of the new national data base and examples of the computer checks and verifications of application information in the Chicago processing system as well as examples of the different ways to retrieve information from the data base. It consists of the following sections:

a. List of Proposed Data Elements for a New Land Mobile Application Form.
b. Examples of computerized Application Processing Checks.
c. Notice of Expired License; and Notice of Impending Expiration and Renewal Application.
d. Data Base Queries.
e. Example of Data Base Extract.

### Accuracy of the Data Base

11. Two of the most important concerns in the design of a license data base for the land mobile radio services are completeness and accuracy. These concerns follow from the functional role of the data base in the frequency selection process. To make the best frequency recommendation for an applicant, the coordinator must have a reasonably complete, accurate, and current knowledge of the radio environment with which the proposed system will interact. This can be provided most reliably by the Commission's data base. In the next several paragraphs, a number of factors which degrade the quality of a license data base are examined together with steps that the Commission has taken in Chicago to overcome them.

12. It must first be recognized that the elements of each license record in the data base are only as accurate as the data submitted to the Commission by an applicant on his application form. Because of the numerous verification checks designed into the Chicago automated system (See Appendix A, Section 2), the information in the data base is identical to that of the application (or corrected application) and the authorized license parameters. The accuracy of the data base thus depends largely on the extent to which each application contains data which accurately describes the actual system to be placed in operation. Major discrepancies between licensed and actual system parameters pose serious potential problems inasmuch as the quality of frequency assignments and efficiency of spectrum utilization can be affected. Our experience in Chicago over the past three years has led us to believe that, for the most part, such discrepancies are not so substantial as to require major attention. However, there is one notable exception.

13. We have compelling evidence to conclude that discrepancies exist between the actual number of mobile units in a fully operating system and the number specified on the application. This is a particularly serious problem above 470 MHz where, unlike the lower bands, the licensed number of mobile units on a channel is the criterion for determining when that channel can no longer be assigned in a particular area. A study of the 470–512 MHz band presented in Appendix B, Part 2, indicates that no correlation exists between the licensed number of mobiles on a channel and the measured level of channel utilization. Similar studies in other bands have also shown that there is no correlation between measured utilization and the "actual" number of units specified on Section III of Form 425. An underlying reason, we suspect, is that many applications overstate the number of mobile units in an attempt to reduce channel sharing.

14. Other factors affecting the accuracy of the land mobile data base are licenses that have expired and unlicensed radio station operation. Since June, 1976, the Chicago Office has been conducting programs which identify expired licenses and those which are about to expire. A computer program identifies those licenses which have expired 90 days or more and creates a mailing list. A license examiner reviews the list for errors and compares it with the application status listing to determine if an application is pending for an expired license. Notice of Expired License, copy of which is included in Appendix A, is then mailed. The licensee has 30 days in which to file a new application or send in a copy of any valid license he may have for the particular station. If there is no response, or if we are advised that the station is no longer in use, the license record is then deleted from the data base.

15. Likewise, the computer generates a notice of expiration/renewal form 45 days prior to the expiration of a license in the data base. This notice and instructions (See Appendix A) are mailed to the licensee listing some of the key license parameters. The licensee desiring renewal and indicating no change in the terms of his existing license, confirms the information, signs and returns the form and subsequently a renewal license is issued. These programs ensure that the data base is kept up-to-date; licensees will be notified of impending expiration; and the need for Notice of Expired License will gradually be eliminated.

16. At this point, we would ask for comments on:

a. The extent and seriousness of discrepancies between licensed and actual system parameters, and what measures the Commission should take to verify the information on application forms.

b. Methods to reduce the impact of the above factors on the data base to be constructed nationwide.

c. Methods by which coordinators, equipment vendors and individuals can supply feedback to the Commission on unlicensed operation, stations never constructed, and those which cease to operate.

### Accessibility of Data Base Information

17. The Commission is considering two different techniques for access to the data base. One is direct "on-line" access where the user interfaces directly with the computer to obtain the desired information. Using the other method, "indirect" access, the user makes a request to the Commission's staff who then interface with the computer and supply the information or printout to the requestor.

18. In the past, we have made the Chicago data base available on a direct on-line basis to parties outside the Commission (See Appendix A, Section 4 for examples of this access). Because of the cost and time considerations of such access to the nationwide data base, it may not be feasible to make this type of access available on a routine basis. We invite comments on the need for such access particularly by frequency coordinators and equipment venders. Comments are also directed to a "third party" option, where a contractor supplies information to all users on a cost-reimbursable basis; under such an arrangement, access could be provided in ways that vary depending on the user's requirements.

19. In addition to the previously covered options, the data base could be furnished, in its entirety or sorted by certain

parameters, such as service, frequency or geographic area. It could be made available periodically via microfiche or printout. This type of access could be employed by someone not requiring totally up-to-date data. The immediate access could be used to supplement the periodically supplied information. This combination would reduce the volume of immediate access with the intent to reduce cost and maintain practicability.

20. The information that the Commission stores in its data base has many potential applications. Some of these are:

a. Resolution of Interference cases.

b. Computation of growth statistics for market projections and, along with monitoring data, support for new spectrum allocations.

c. Day-to-day use by coordinators for frequency recommendations and by the users where there is no provision for coordination.

d. Resolution of a difficult frequency selection situation where no adequate frequencies appear to be available for a given need.

### Request for Comments

As the Commission proceeds to design its national land mobile data base, it would like to have comments on these specific questions:

a. Appendix A includes a list of proposed data elements. Are these adequate, or are there items which should be added to this list? Are there items which can be dropped with little or no impact on the data base viability?

b. The Commission is concerned about the possible discrepancies between licensed and actual system parameters with particular emphasis on the number of mobile units. What is the extent and seriousness of this and what measures should be taken to verify the information and reduce the impact on the national data base?

c. In making the data base information available, what is the most desirable or beneficial method with which to provide it? The Commission is looking for the differing requirements; i.e., a coordinator may have different needs than a vender or the general public. What are the minimum data elements needed in the frequency selection process?

d. Is it practicable to develop methods by which coordinators, equipment venders and individuals can supply feedback to the Commission on unlicensed operation, stations that were never constructed and those which cease to operate? If so, what form should this feedback process take?

## II. Frequency Selection

21. The Commission designed, developed and implemented a computerized frequency selection program (hereinafter AFAM) that has been operating in Chicago for the last several years. A brief description of the component elements of the program has been set out below, and an extensive report has been published. (Tremper, P., Automatic Frequency Assignment Model (AFAM)); FCC Report No. SMTF-75-01 (1975). The Chicago experience has persuaded us that it is not presently feasible or desirable for the Commission to undertake the function of frequency selection nationwide, as was originally proposed in Docket 19150. The rationale for this conclusion is complex, but essentially it derives from the unwieldy number of variables involved in making good frequency selections. We have determined that a system of private frequency coordinators, representing the various service groups, offers a more realistic way of coping with these variables in a nationwide setting than does a set of computer programs, even programs as ambitious as AFAM. Consequently, AFAM will not continue as a production program. It will be revised and simplified and be made available as a tool for use in situations where the coordinator is not able to suggest a frequency that is acceptable for an applicant's use. The Commission will use component elements of AFAM in performing its audit function.

22. The Commission will initiate a separate proceeding dealing solely with the frequency coordination function. The purpose will be to develop rules and standards by which the coordinator will operate. Presently there is very little standardization in the coordination function. Even within some radio services, there are variations in the way in which frequencies are recommended. The frequency coordinators are not at fault in this regard because the Commission has not provided them with standard procedures or with general rules for operating. While a number of land mobile associations have developed guidelines for use by coordinators, no standardized program has been undertaken by the Commission. This deficiency must be corrected. Comments are invited on how the Commission can most effectively set about the task of developing proposals for these rules and standards.

23. The Commission recognizes that the various coordinating committees are structured differently and employ methods that vary widely in their degree of sophistication. For instance, some coordinators base their recommendations only on co-channel station separation and are guided by minimum separation standards. Others perform more detailed interference analysis, take into account the number of mobile units on a channel, and may even be concerned with limiting antenna heights and effective radiated powers of proposed stations. We realize that the different methods are influenced to a certain extent by transmitter density and the operational needs of the given radio services. However, we also believe that certain "rules of thumb" such as minimum geographic station separation for a given service afford that service a luxury not attainable to other services with equal or perhaps even higher priority needs.

24. We plan to provide coordinators with channel occupancy data in the form of "low", "medium" and "heavily used" channels. This will be limited to major urbanized areas and areas where a compelling need is manifested and will become available gradually over the next several years. In our audit procedures, the license data base and monitoring data will be used to insure that all channels are loaded in an equitable manner. This information will also guide the Commission in evaluating or initiating recommendations for geographical interservice sharing and/or frequency re-allocation. The Commission will apply its automated frequency selection model on selected applications as a check on the frequency recommendation of the coordinator and/or vender. The frequency selection model will also aid the Commission in resolving coordinator/applicant disputes and in other difficult frequency selection cases. The Commission also will retain the provision for an "engineering field survey" as an alternative to frequency coordination. We anticipate that the license data base and monitoring data (where available) will substantially assist those applicants pursuing this option.

25. In view of our intended use of the automated frequency selection model (AFAM) and its potential usefulness to the coordinators and/or venders, we will give a brief description of its operation here. We would point out that AFAM is an integrated assembly of engineering models and routines which can be used independently as needed. Furthermore, each of these models could be adapted to a form that would not require channel monitoring data as an input. Present inputs to AFAM, in addition to the monitoring data, are the license data base and the technical parameters of a proposed system. (The license data base and monitoring data are described in section I and III and the Appendices.) The engineering routines sequentially: (1) recommend a combination of antenna height and effective radiated power appropriate for the service area specified in the application, (2) determine a listing of frequencies available for the instant application, and (3) rank the frequencies on the combined basis of estimated level of usage to the applicant and adverse impact on existing co-channel and adjacent-channel stations. Since the routines are modular, we would ask the coordinator/vender to comment on those most useful to their purposes.

26. The automated frequency assignment model is comprised, in part, of the following routines:

a. *Frequency Eligibility*: This routine generates a list of eligible frequencies for the applicant's proposed radio service, frequency band, and mode of operation (for example, the Business Radio Service, 150 MHz band, and one-way paging). Next, frequencies with limitation not in conformance with system parameters are eliminated (for example, the proposed antenna height exceeds the maximum allowable).

b. *Occupancy Retrieval*: For each eligible frequency, occupancy and waiting time parameters are retrieved from data taken at the nearest monitoring site to the proposed base station location

(See Appendix C). The frequencies are then ranked according to calculated waiting time.

c. *Co-Channel Interference Model:* A group of the frequencies having the lowest waiting times is analyzed with respect to intereference potentials to and from existing stations. The current model considers all stations within 100 miles of the proposed station. For each station in this environment, a propagation analysis is made to determine the extent of interference to and from the proposed station. This depends on the distance to the stations, antenna heights and effective radiated power, the frequency band and other factors.

In the co-channel and other engineering models to follow, the projected interference levels are weighted by the probability that an interfering station will be transmitting. This probability is derived from channel occupancy data taken at the monitoring site nearest the interfering station. The weighted interference levels are thus a measure of channel degradation to and from existing stations.

d. *Adjacent Channel Model:* A smaller group of those frequencies having the lowest co-channel interference potentials are further analyzed to determine the effects of interference to and from nearby stations operating on frequencies close to, but different, from that of the proposed station. This analysis is somewhat similar to that described above, with the exception that an adjacent channel correction figure, representing the level of transmitter noise at the given frequency separation, is applied. These correction figures are based on information supplied by radio equipment manufacturers.

e. *Intermodulation Model:* A further reduced number of frequencies which have passed the co-channel and adjacent channel models is analyzed with respect to intermodulation interference; i.e., interference caused by the mixing of two or three off-channel signals to produce a composite signal falling on the proposed frequency. Transmitter and receiver intermodulation interference, both to and from existing stations, are calculated.

f. The combined effects of the three interference models are calculated separately for interference to and from the environment. The final figures are weighted so that interference to the environment is given twice the importance as that from the environment. The net frequency ranking parameter is the "level of service"; expressed as a percentage on a scale from 0–100 percent; 100 percent being the best possible level.

27. The output of the automated frequency selection model consists of computer generated "frequency recommendation" printouts containing the following information for each recommended frequency: level of service, occupancy, waiting time, suggested antenna height and effective radiated power, and a listing of all co-channel licensees operating within a 20 mile radius of the proposed base station location. A copy of the frequency recommendation printout is included in Appendix C.

### Frequency Coordination in the Chicago Region

28. While the Commission is developing procedures for the coordinators, it intends to return to frequency coordination in the Chicago Region by deleting those portions of the Rules that permit the filing of applications without evidence of frequency coordination. Effective September 1, 1977, the Commission will no longer accept applications that are not accompanied either by evidence of frequency coordination or by a field survey as now permitted in areas outside Chicago. A brief order will be issued within the next ninety (90) days making this Rule change, effective September 1, 1977. To prepare for this return of responsibility, each coordinating group should address itself to the need for information from the Chicago data base. The staff will assign a high priority to providing the information requested. Each coordinating group is invited to comment on any aspect of the burden that a return to coordination will entail.

### Request for Comments

The Commission has requested comments on the makeup and use of the nationwide data base in preceding paragraphs. Response to those questions should similarly be directed, where applicable, to the frequency selection process:

a. The Commission has decided to return to the frequency coordinating committees in the Chicago Region where the Regional Office has performed this function since October, 1974. With respect to this decision, what information (license data base, monitoring information, etc.) and assistance from the Commission will the coordinating committees need to effectively resume their role in providing frequency recommendations?

(1) Does the proposed date of the resumption of the frequency coordination in Chicago (September 1, 1977) allow adequate lead time to prepare for the takeover.

(2) The Commission will be refining its review and evaluation of the coordinator's recommendations in the Chicago Region as it prepares the design of the nationwide system. We invite suggestions, especially from coordinators in that area, as to what are the best methods of interface between the Commission and the coordinators so that each may be aware of the other party's actions.

b. The Commission seeks the viewpoints of the land mobile community on which types of applications should require frequency coordination (or an engineering field survey) and how this coordination can best be accomplished.

(1) Should, for example, coordination be required in all frequency bands; including the 800 MHz band? Should other than initial users of shared mobile relay systems be required to obtain coordination? Should participants of "approved" frequency assignment plans be exempted from frequency coordination requirements? Should the Commission develop standards and criteria from which to evaluate and approve statewide or area-wide plans or should these plans be administered through the applicable coordinating committee?

(2) Can radio services having similar spectrum requirements better be served by a single coordination committee? Could this facilitate implementation of any future interservice or geographical sharing between these services?

c. The Commission intends to develop rules and standards to govern the frequency coordination process. We will also develop methods by which the performance of the coordinators and adherence to our standards can be evaluated. In this regard, we raise the following possibilities:

(1) Should the coordinating committees be given the authority to suggest standards relating to system coverage; i.e., insuring minimum necessary antenna height and/or effective radiated power? Should a frequency recommendation be contingent upon meeting such standards?

(2) In those areas where the Commission has conducted channel monitoring, should occupancy levels be established for determining when a channel could no longer be assigned in that area?

(3) In the interests of spectrum conservation should standards be developed to insure that licensees of a shared transmitter facility have similar coverage area requirements?

(4) What procedural interface with the Commission should be established to handle disputes between the coordinators and applicants? Should the Commission then recommend a frequency to the applicant directly or work through the coordinator?

## III. Spectrum Monitoring

29. The Commission has conducted an extensive spectrum monitoring program in Chicago over the last four years. The program is described briefly in a report contained in Appendix B to this Notice entitled "Interim Progress Report on Spectrum Monitoring". The Report presents some significant results of a number of analyses completed to date and illustrates the various types of channel utilization data that can be made available. As a result of experience with the Chicago monitoring program, the Commission has substntially reduced the scope of spectrum monitoring in Chicago; but it intends to develop plans for monitoring in other congested areas in the country.

### Future Plans for Spectrum Monitoring

30. Two decisions affect the course of spectrum monitoring in the future—the Commission's decision to transfer the Chicago licensing functions to Washington and centralize the spectrum management efforts there, and the return of the frequency coordinating committees to the frequency selection process for Chicago Region applicants.

31. Once coordinators re-enter the frequency selection process, we will further reduce the amount of spectrum monitoring in the Chicago Region. Production monitoring to support the automated frequency selection program (AFAM) will be discontinued. Until the coordinating committees resume the coordination role in July, the Chicago monitoring operations must continue to collect data to support current licensing functions. The number of production monitoring sites has been reduced from the original 56 to 30 sites. We are currently looking to concentrate monitoring activities in or near the larger urbanized areas close to Chicago. Eleven sites are now contemplated to cover the metropolitan areas of Chicago and Milwaukee by employing a receiving antenna height of 50 feet.

32. Future spectrum monitoring will be concentrated in the larger urban areas and in locations identified or suspected as being congested areas. Such monitoring will include areas other than the Chicago Region but will not be as intensive as the monitoring previously conducted in Chicago. Our plans are to collect data for the purpose of providing spectrum utilization statistics and analyses to (1) aid in frequency selection by users and coordinators, (2) serve as a tool for the Commission to review and evaluate the coordinator's performance, and (3) as input to our spectrum management program and allocation/reallocation proceedings. We plan to develop usage characteristics peculiar to each radio service or group of users that will supplement other methods of frequency selection. These characteristics will enable us to accurately monitor the growth and dynamics of land mobile usage. As these plans develop, we expect to provide spectrum monitoring capabilities in other urban areas of the country outside the Chicago Region as the need is defined by the Commission's staff and the land mobile community.

33. Appendix B to this Notice contains an "Interim Progress Report on Spectrum Monitoring." Part 1 of this Report defines the occupancy parameters we use to describe channel utilization and illustrates the various types of information retrievable from the special Long-Term Monitoring Project data and from the production monitoring data base. Part 2 examines the relationship between mobile loading standards of the Rules and actual on-the-air usage measured by our monitoring equipment.

34. With respect to the future plans for monitoring set forth above and the information presented in Appendix B, we are requesting specific comments on the following issues:

a. In what congested areas and in what parts of the spectrum should the Commission concentrate its monitoring efforts?

b. How should monitoring data be made available? On a periodic basis? By Public Notice? Commission Reports? Upon specific request? On a regular basis only to those involved in frequency selection/coordination?

c. What monitoring information would be useful? In what format is it most useful?

d. How should frequency coordinating committees use spectrum usage information in their process of recommending frequencies to individuals? What formats would be of interest to the general public, venders, coordinators, etc?

e. In areas where monitoring information has been gathered, can the channel usage data be used as a method of determining channel loading in lieu of the mobile loading standards now in the Rules? Should the cutoff level be made a hard and fast Rule or should it be a tool to use as a guideline?

f. Given accurate channel usage data, what parameter(s) (occupancy, waiting time, etc.) are of value in determining whether individual channels have high or saturated use, medium or low use? Should it be usage in a peak period or an average over a day, week, month or year?

g. How should the monitoring program and procedures for making available the usage data be structured to be of maximum benefit to land mobile users?

h. What standards should be developed to insure that, when additional users are added to low and medium use channels, saturation does not result, thereby reducing the level of service for all?

## IV. Frequency Sharing

35. As indicated, the Commission has reduced the level of its financial commitment to the spectrum management program. There is no lessening of the Commission's commitment to improving the utilization of frequencies in areas of significant congestion. For the present, we have determined that it is neither technically nor financially feasible to implement channel sharing as extensive as that proposed in Docket 19150. There is sufficient capability in Chicago, however, to extend the sharing of channels without damaging the systems now operating and without incurring heavy administrative costs. The staff will develop proposals for increasing the sharing of frequencies in the Chicago Region, and these proposals will be issued within the next several months in further reports in this proceeding. Active involvement of land mobile users, coordinators and vendors in the development, consideration and implementation of these proposals is vital. Comments are invited on the best means of accomplishing this involvement.

36. The Commission has sufficient data base information in the Chicago Region to make possible the wider sharing of frequencies between services. No specific sharing proposal is being made at this time, but the staff is currently developing the definitions that will be essential to any workable sharing proposal. These definitions have been set out below for comment.

### Saturation and Loading

37. The pressing need for more spectrum, expressed so often by the various associations of land mobile users, has forced the Commission to deal with congestion and channel loading in terms that have accepted meaning and with procedures that are relatively simple, straightforward and readily available without relating these criteria to any quantum measurements. Definitions of saturation and channel loading criteria are not easily derived. In order to provide a more objective evaluation of congestion, an improved measure of channel capacity and overall radio system performance is needed. We must develop a comprehensive, accepted method of measuring spectrum need of land mobile users. To this end, we would direct comments to the following discussions relative to saturation and loading.

38. When speaking of congestion in urban environments, both the Commission and the radio users have used the term "saturated channel". The Commission should be asking, "Saturated, in what respect? What is saturation, and how is it measured?" and attempting to answer these questions. Before developing the criteria of measurement, the Commission and the land mobile community should agree on some generic definitions. Other criteria may be developed within the context of these definitions:

A. *Saturation Level.*—In an absolute sense, the level of channel usage on a heavily used channel at which the addition of one or more users would seriously disrupt the use of that channel.

B. *Optimum Loading Level.*—The preferred level of channel usage at which the Commission would recommend not authorizing additional licensees to use a given channel on a time-sharing basis in the same geographic area.

39. Such definitions would be our basic starting point, and other criteria for measurement of usage, channel capacity and spectrum needs would follow. From use of the monitoring and license data base from Chicago, we hope to quantify these definitions or, at least, have a much better feel for them than we now have. There are, of course, other factors such as whether waiting time or response time is of primary consideration. Further discussion of these matters is contained in Appendix B.

### Channel Utilization Information

40. For the purpose of supplying channel utilization information to those persons in the frequency selection process for the Chicago Region, the Commission proposes grouping frequencies into four broad categories of level of usage. These levels are based on measurements conducted over normal business working days and are further explained in Appendix B.

A. *Low Occupancy Channels.*—Those frequencies having either daily average occupancies of 0–10% or peak hour occupancies of 0–15%.

B. *Medium Occupancy Channels.*—Those frequencies having either daily average occupancies of 10–25% or peak hour occupancies of 15–40%.

C. *Medium High Occupancy Channels.*—Those frequencies having either daily average occupancies of 25–40% or peak hour occupancies of 40–60%.

D. *Very High Occupancy Channels.*—Those frequencies having either daily average occupancies greater than 40% or peak hour occupancies greater than 60%.

41. The above categorization is based on measured transmission occupancy as observed by the Commission's Regional Staff over the past few years. Measured transmission occupancy is the percentage of the montioring period in which a carrier frequency is detected as present on the channel being sampled by the monitor receiver. Those persons unfamiliar with the nature of mobile radio might think the above figures too low to indicate a high level of usage. Thus, we must distinguish transmission occupancy from message occupancy. The latter value will generally be greater since pauses, or gaps, exist between the series of transmissions in a message. Studies also show that "message throughput" on a channel may actually decline when transmission occupancy exceeds sixty percent (60%). This is because each user must compete with other users to complete a message that requires more than one transmission.

42. The Commission has established a limited objective for sharing in the Chicago Region. That is to determine the feasibility of working with the coordinators and venders to implement sharing in the Chicago Region, where the license data base provides a means of detecting possible channel availability. At this time, the Commission is interested in studying the feasibility of voluntary sharing arrangements, based on the Chicago data. No sharing will be authorized without the advance notice and consent of the frequency coordinating committees involved. Interested parties are encouraged to comment on the best way of effecting voluntary arrangements. If our experience over the next several months is positive, further proposals of a more specific nature will be forthcoming in this proceeding.

## Conclusion

43. The essential distinction between the spectrum management program now being developed and the earlier program contemplated in Docket No. 19150 is the substantial reliance we are placing on the private sector. Initial selection of frequencies will be the responsibility of the applicant on the recommendation of the frequency coordinator. Decisions regarding system engineering will be left to the user and his equipment supplier. The Commission cannot perform either function under present restraints of money and personnel. We are convinced, in fact, that it is better not to have Commission involvement in these details. This is not an abrogation of our responsibility to license systems in the public interest. We intend to propose standards and establish rules; to enforce their fair application; and to assist the users, coordinators, and venders to achieve maximum utilization of the spectrum. The establishment of an effective working relationship between these interests and the Commission is a principal goal of this proceeding.

44. This action is taken pursuant to Sections 4(i), 303 and 403 of the Communications Act of 1934, as amended. Interested parties responding to this Inquiry shall furnish comments on or before July 15, 1977, and reply comments on or before August 15, 1977. All relevant and timely comments and reply comments will be considered by the Commission before reaching its decision in this proceeding; other relevant information, in addition to the specific comments invited by this Notice, may also be taken into account by the Commission. Because of the complex nature of this Inquiry, answers to the more detailed issues, if received after the specific date, will be considered. The Commission will issue a "Further Notice of Inquiry" subsequently, if it determines a need to delete, substantially modify, or clarify any of the announced objectives.

45. In accordance with provisions of § 1.419 of the Commission's rules, an original and six (6) copies of all comments, suggestions, pleadings, briefs, or other documents shall be furnished the Commission. Responses will be available for public inspection during regular business hours in the Commission's Information and Docket Reference Room at its headquarters in Washington, D.C.

Federal Communications Commission,
Vincent J. Mullins,
*Secretary.*

## Appendix A

### The License Database

1. Questions on new form

*Item Number and Element Title or Description*

1. Applicant's Legal Name and Mailing address:
A. Name
B. Address
2. Name of Radio Service
3. Purpose of Application:
A. License for new station
B. License renewal
C. License modification (complete Item 5)
D. Add station to system
E. Assignment of license (see instructions)
F. Other (specify below)
4. If station is presently licensed, give: Call sign
5. Nature of Proposed Modifications:
A. Increase power
B. Relocate station/antenna site
C. Change Area of operation
D. Change Radio frequency
E. Increase Antenna Height
F. Other (specify below)
6. Class of Station:

I. *Fixed location*

A. Base
B. Control (for mobile relay)
C. Mobile relay
D. Other (specify below)

II. *Mobile* (Enter actual No. of Units)

A. Land Vehicle
B. Aircraft
C. Watercraft
D. Hand-held Portable
E. Paging receivers
F. Other (specify below)
7. Details of Station at Fixed Location:
A. Transmitter Site No. (if more than one)
B. Total Height of antenna structure (AG)
C. Height to tip of your antenna element (AG)
D. AAT, if required
E. Ground elevation (AMSL)
F. Latitude
G. Longitude
H. Location of transmitter
I. City
J. County
K. State
L. If antenna will be mounted on an existing antenna structure, give name of a licensee using this structure, his call sign, and radio service.
8. Technical data: The following elements would be in matrix form for each of pair of transmit/receive frequencies:
A. Frequency (Transmit and receive)
B. Type of Unit Codes (from Item 6)
C. Number of Units
D. Frequency Usage Codes (Particulars of Operation)
E. Output Power
F. Power Losses between transmitter (or receiver) and antenna
G. Antenna Gain
H. ERP
I. Antenna Height
J. Emission Designators
9. Written description of mobile operating area.
10. Area of operation/coverage area:
A. Latitude of center
B. Longitude of center
C. Radius
11. Other stations in system: Call Signs
12. Control points:
A. Indicate control point locations by street address (or other narrative description if street address is not appropriate)
B. Telephone No. of principal control point.
13. Eligibility
14. will any of the radio facilities (equipment) proposed or covered by this application be utilized in a shared mobile relay system? If yes, give name of owner:
15. Air Hazard Information:
A. 20 feet above ground question
B. 20 feet above supporting structure question
C. Height of supporting structure
D. Type of supporting structure
E. Has notice of construction been filed with the FAA? (On FAA Form 7460–1) If yes, give: a. Date filed b. FAA office where filed
16. EPA Question
17. Government Land Question
18. Communication Service Question
19. The applicant hereby authorize the Commission to contact the below listed person with regard to clarifying technical information submitted on this application:
A. Typed name
B. Address
C. Telephone Number
20. Certification (Privacy Act Notification to be included)

*Remote Receiver Data*

It is envisioned that remote received data would be filed on a separate form. A question would be added to the above elements which would indicate the filing of this separate form.

Supply the following information for all receiver sites not located at the transmitting site(s) specified in Item 7 of Form -------- and associated with a particular station:

A. Call sign
B. Remote receiver data
1. Site number
2. Receive frequency
3. Latitude
4. Longitude
5. Ground elevation
6. Antenna height
7. Antenna gain

It would be possible to enter many combinations of location and frequency on one page.

## 2. EXAMPLES OF APPLICATION PROCESSING CHECKS BY THE COMPUTER IN THE CURRENT CHICAGO SYSTEM

The following are examples of approximately 70 checks performed by the computer on each application filed with the Chicago Regional Office:

(6) "CALL SIGN INVALID"
Not a valid Call Sign.

(12) "NOT IN SPECIFIED STATE/COUNTY"
Latitude and Longitude are not in the specified state/county.

(17) "SITES NOT COLLOCATED"
Applicant indicated collocation with another site, but they are more than one second apart.

(20) "MOBILE UNITS IN SECTION III MORE THAN SECTION II"
Number of actual mobile units exceeds number applied for.

(27) "CANADIAN COORDINATION REQUIRED"
For the specified location, Canadian coordination is required.

(31) "INVALID COMBINATION OF LETTERS"
The entry for Paticulars of Radio Operations is invalid.

(40) "EQUIPMENT TYPE NOT RECOGNIZED"
Equipment type entered is not on file. Spelling may be incorrect. Correct entry or enter new type via DBM.

(52) "COULD NOT CHECK TX FREQUENCY VS. SERVICE"
One or more of the following items is invalid: frequency, or output power.

(64) "SLOPE FROM TOWER TO RUNWAY EXCEEDS LIMIT"
FAA coordination is required.

(65) "IRAC COORDINATION REQUIRED"
Frequency is in a government band.

(68) "POWER EXCEEDS LIMIT"
Effective Radiated Power exceeds the calculated limit. Check input and output power and antenna gain for validity. Check with engineering section.

FCC FORM 1040-C DATE OF THIS NOTICE

NOTICE NOV 4 76

ACCORDING TO OUR RECORDS, THE LICENSES FOR THE REFERENCED CALL SIGN HAVE EXPIRED. APPLICATIONS FOR LICENSE RENEWALS SHOULD BE RECEIVED BY THE COMMISSION WITHIN 90 DAYS, BUT NOT LESS THAN 30 DAYS PRIOR TO EXPIRATION. AS OF THE DATE OF THIS NOTICE, WE HAVE NOT RECEIVED ANY APPLICATIONS AT THIS OFFICE RELATING TO THE LISTED FACILITIES AND THIS NOTICE SERVES TO INFORM YOU THAT ALL PERTINENT RECORDS WILL BE REMOVED FROM OUR FILES. IF OUR RECORDS ARE INCORRECT BECAUSE YOU INADVERTENTLY FILED FOR RENEWAL OR MODIFICATION THROUGH OUR WASHINGTON OFFICE, PLEASE SEND US A REPRODUCED COPY OF YOUR CURRENT LICENSE SO THAT WE CAN UPDATE THE RECORDS PERTAINING TO THIS STATION.

OPERATION OF RADIO FACILITIES WITHOUT A VALID RADIO STATION LICENSE IS IN VIOLATION OF THE COMMUNICATIONS ACT OF 1934, AS AMENDED. IF YOU HAVE A NEED TO OPERATE RADIO FACILITIES IN THE LAND MOBILE SERVICES, COMPLETE THE NECESSARY APPLICATIONS, REQUESTING A NEW LICENSE, AND FORWARD TO THIS OFFICE WITH THE CORRECT FILING FEE FOR EACH APPLICATION (SEE RULES SUBPART G, PART 1 FOR REQUIRED FILING FEES). BLANK APPLICATION FORMS ARE AVAILABLE AT THIS OFFICE, THE FIELD OPERATIONS OFFICES AT CHICAGO, DETROIT, OR ST. PAUL, OR FROM YOUR EQUIPMENT VENDOR, UPON REQUEST.

A COPY OF THIS NOTICE INFORMATION IS BEING PROVIDED TO THE FIELD OPERATIONS OFFICE IN YOUR DISTRICT.

FEDERAL COMMUNICATIONS COMMISSION
CHICAGO REGIONAL OFFICE
PARK RIDGE, ILLINOIS 60068

LEGAL NAME:
CITY OF BIG RAPIDS, MICH

EXP. DATE: JUL 30 76

CALL SIGN: KIE555

CITY OF BIG RAPIDS
POLICE DEPARTMENT
226 NORTH MICHIGAN AVENUE
BIG RAPIDS, MICHIGAN 48307

FEDERAL COMMUNICATIONS COMMISSION
WASHINGTON, D. C. 20554

FCC FORM 405-C(Test) DATE OF NOTICE:

EXPIRATION NOTICE & RENEWAL APPLICATION
(SEE CORRESPONDING INSTRUCTIONS - ENCLOSED)

| CALL SIGN: | EXPIRATION DATE: | CLASS OF STATION: | TRANSMITTER COORDINATES (OR MOBILE OPERATING AREA): |
|---|---|---|---|
| KZY 999 | DECEMBER 20,75 | MOBILE RELAY | 42 -32 - 01W 90 - 25 - 36W |

LICENSEE LEGAL NAME & IDENTIFICATION NUMBER
HAZEL GREEN RESCUE SQUAD, INC. 0003308401

FREQUENCIES (MHZ):

| | |
|---|---|
| 152.0075 | 150.775 |
| 155.160 | 155.235 |
| 155.175 | 155.265 |
| 155.205 | 155.280 |
| 155.220 | 155.295 |

APPLICANT CERTIFIES THAT THERE ARE NO CHANGES TO THE DATA OR AUTHORIZED PARAMETERS SHOWN ON THE STATION LICENSE BEING RENEWED OR IN THE INFORMATION CONTAINED IN THE APPLICANT'S MOST RECENT FULL APPLICATION OTHER THAN THOSE PERMITTED BY THE INSTRUCTIONS FOR THIS FORM. APPLICANT WAIVES ANY CLAIM TO THE USE OF ANY PARTICULAR FREQUENCY AS AGAINST THE REGULATORY POWER OF THE UNITED STATES BECAUSE OF THE PREVIOUS USE OF THE SAME, WHETHER BY LICENSE OR OTHERWISE. THE STATEMENTS IN THIS APPLICATION ARE TRUE, COMPLETE, AND CORRECT TO THE BEST OF MY KNOWLEDGE AND BELIEF AND ARE MADE IN GOOD FAITH.

WILLFUL FALSE STATEMENTS MADE ON THIS FORM ARE PUNISHABLE BY FINE AND IMPRISONMENT. U.S. CODE TITLE 18, SECTION 1001.

SIGNATURE OF INDIVIDUAL, PARTNER, OR AUTHORIZED PERSON ON BEHALF OF A GOVERNMENTAL ENTITY, OR AN OFFICER OF A CORPORATION OR ASSOCIATION.

SIGNATURE _____ DATE SIGNED:_____

FEDERAL COMMUNICATIONS COMMISSION
CHICAGO REGIONAL OFFICE
PARK RIDGE, ILLINOIS 60068

HAZEL GREEN RESCUE SQUAD, INC.
P O BOX 373
HAZEL GREEN WI 53811

INSTRUCTIONS FOR FCC FORM 405–C (TEST)

NOTICE TO INDIVIDUALS REQUIRED BY PRIVACY ACT OF 1974

Sections 301, 303, and 308 of the Communications Act of 1934, as amended, (license powers) authorize the FCC to request the information on this application. The purpose of the information is to determine your eligibility for a license. The information will be used by FCC staff to evaluate the application, to determine station location, to provide information for enforcement and rulemaking proceedings, and to maintain a current inventory of licensees. No license can be granted unless all information requested is provided.

1. The FCC Form 405–C (Test) may be used in applying only for the renewal of licenses for the station listed on the face of it.

2. The form may not be used if there has been any change in the information contained in the most recent full application on file with the Commission, except the following changes:

Mailing name and address.

Licensee legal name (if no change in ownership, control, or corporate structure).

Equipment data (if technical parameters do not exceed those stated on the most recent full application).[1]

Reduction in the number of mobiles, antenna height, antenna gain, or effective radiated power (ERP).[1]

Tone squelch (PL) frequencies.[1]

3. A separate Form 425 application for modification must be filed for any of the following station changes (a modified license must be obtained from the Commission prior to making such changes):

Relocation of station (including antenna location).

Area of operation.

Increase number of mobiles (including hand-held units), antenna height, antenna gain, or power.

Add or change frequencies.

Add or change Control Points.

Change emission.

Note.—Frequency coordination must accompany application as applicable.

4. If a license contains an "overpowered" Special Condition, submit one of the following with this form:

Explanatory information as required under Item 2 to reduce the power to the minimum level necessary for satisfactory operation.

Engineering justification to substantiate the requested power (this justification will be determined prior to granting renewal).

5. If a renewal is not desired, line through the call sign and return the form with the license for cancellation. (Merely line through the frequencies to be deleted, if any of the frequencies are no longer required.)

6. The expiration dates for all licenses granted under one Call Sign will be conformed under this renewal process.

7. Enclose correct fee with this application (see Rules Subpart G, Part 1). Do not send cash. Make check or money order payable to the Federal Communications Commission. This is a filing fee and will not be refunded even though the application is not granted.

8. Mail to Federal Communications Commission, Chicago Regional Office, Park Ridge, Illinois 60068. Phone: (312) 298–0290.

9. The form should reach the Commission's Chicago Office prior to the license expiration date so that the licensee may continue to operate until notified by the Commission of action on the application. If the application is not returned by the licensee within the prescribed time, the station will be considered no longer in operation, and all associated license records will be removed from the Commission's files.

*4. Data Base Queries*

License records in the data base are retrievable by input of the following primary search key parameters, among others:

1. Call Sign
2. Licensee ID Number
3. Licensee Name
4. Frequency
5. Service
6. Rectangular Geographic area
7. County and/or State
8. Expiration Date
9. License Number

The following pages contain examples of various types of retrievals available for obtaining information from the license data base:

1. Pages 4.2 through 4.5—Data Base Queries from a remote terminal.

2. Pages 4.6 through 4.8—Geographic/Frequency Search run by the Chicago Regional Office on request.

3. Pages 4.9 and 4.10—Geographic/Frequency Search accomplished by the Environment Data Retrieval (EDR) program (used internally by the Regional Office staff and an integral part of AFAM). Page 4.10 is a plot of the data exemplified by the printout on page 4.9.

4. Page 4.11—Special retrieval program similar to the geographic/frequency searches but which selects only co-channel and adjacent channel stations in the environment producing a calculated signal above threshold at a given location.

[1] Please note and explain on an attachment to this application any changes in the last three items (this is necessary to update license records). If the licensee's legal name has been changed, a letter of explanation must be submitted with this application.

Sample Printout: Remote Teletype Terminal

(Underlined elements are User inputs)

The following is an example of correct terminal connection procedure:

```
UNIV01

UNIVAC 1108 TIME/SHARING EXEC  VERS 225/3A1/G

@RUN QUERY,ACSI01,REMOTE

DUP ID, NEW ID IS QUERYA
DATE: 072073      TIME: 153841

@XQT FCC*QUERY.1

FCC CHICAGO REGION. DATABASE QUERY
ENTER USER NAME

XXXXXXX

GO

LOGGED IN. DATE: 072073 TIME: 153953
```

(The following is an example of retrieval of license records by call sign)

```
LIST/1/WWW73

    1 LICENSES FOR CALL SIGN WWW73
CIS731560034
 TX FX1  456.9250M WWW73   40-27-44N  89-56-18W IL057 123.0H 80DB
 RX      451.9250M         40-27-44N  89-56-18W       123.0H
 TIME LEFT 00:16:05
```

To retrieve detailed license records, the User now enters:

```
LIC/CIS731560034

LICENSE CIS731560034 (L) FX1  SUMMARY DISPLAY          WWW73    FREQ   456.925 MH
LSCEE 00010396  FAC-NO 01  SYS-NO 01   SUPSYSNO 0       APPN CIS731224071
DATES EXP 78 6 5  GRANT 730605  LAST-TR 060573   APPLCNT CORPORATION   SICC

NAME CANTON CONCRETE PRODUCTS CO.
ADDR CANTON CONCRETE PRODUCTS CO.
     P. O. BOX 539
     CANTON, ILLINOIS 61520
 TIME LEFT 00:12:38

NEXT

LICENSE CIS731560034 (L) FX1  TRANSMITTER DISPLAY      WWW73    FREQ   456.925 MH

LA  40/27/44N   WEST EDGE OF DUCK ISLAND WHICH IS          TSF 123.0H         16F3
LO  89/56/18W   LOCATED 5 MILES SOUTH OF BANNER,           SYS-D YES
PI   50.00W     ON ILL                          BANNER      IL   57
PO   18.00W   HRS 600 --2000 PKS 800 , 1700              OPNS B G R
ERP 120.00W   MFG 6335  TAC CC4027C              MOD
ANTENNA   9 DB       320     DEG-AZ     NONE
    EL 453   ANTHT 59     STRHT 60   OAHT 60      STRUCTURE TWR    POLAR VERT
OPSAREA-CNTR    -SIDES    -ANGLE -AREA    ANT-MFG 6335  MOD TDE6030
LA  40/29/29N     1.MI 50 DEG
LO  89/58/30W     8.MI
 TIME LEFT 00: 08:43

END

THE DATABASE HAS BEEN CLOSED

@FIN
```

A search by geographic area or county can be made by entering either:

AREA/40-30-00/ 90-01-00/10.0
FREQ/450/460
SERV/IS////I

or:

COUNTY/IL/057
FREQ/450/460
SERV/IS////I

```
CIS731560034
 TX FX1  456.9250M WWW73   40-27-44N  89-56-18W IL057 123.0H 90DB
CIS731560035
 TX FB2  451.9250M KSE940  40-30-49N  90-01-42W IL057 123.0H 87DB
CIS731560034
 RX      451.9250M         40-27-44N  89-56-18W       123.0H
CIS731560035
 RX      456.9250M         40-30-49N  90-01-42W       123.0H
CIS731560036
 MO MO   456.9250M KZ9048  40-30-39N  90-01-42W IL057 123.0H

 TIME LEFT 00:09:24
```

Detailed license information is retrieved as before by entering:

LIC/CIS731560034

Summary Display, as shown on previous page, will be printed

NEXT

Transmitter Display for WWW73 will be printed

NEXT

Receiver Display for WWW73 will be printed

TIME LEFT 00:05:48

LIC/CIS731560035

Summary Display for KSE940 will be printed

NEXT

Transmitter Display for KSE940 will be printed

NEXT

Receiver Display for KSE940 will be printed

TIME LEFT 00:03:40

LIC/CIS731560036

Summary Display for KZ9048 will be printed

NEXT

Mobile Display for KZ9048 will be printed

TIME LEFT 00:00:42

END

THE DATABASE HAS BEEN CLOSED

@FIN

THIS IS THE GEOGRAPHIC-FREQUENCY SEARCH RUN FOR YOU BY THIS OFFICE OF THE F.C.C.

THE FOLLOWING INPUT PARAMETERS WERE USED:
CENTER POINT OF THE SEARCH WAS AT
LATITUDE 41/42/56
LONGITUDE 88/21/ 8
THE RANGE WAS 50 MILES
THE FREQUENCY BAND SEARCHED WAS 158805000 TO 158805000 HZ

THE TRANSMITTER RECORDS LIST THE FOLLOWING INFORMATION:
(1)OPERATING FREQUENCY
(2)NAME SORT FIELD WHICH IS THE COMPUTER NAME FOR THE LICENSEE
(3)CALL SIGN
(4)LATITUDE AND LONGITUDE OF THE TRANSMITTER
(5)TSF OR TONE SQUELCH FREQUENCY (IF USED)
(6)THE HEIGHT OF THE ANTENNA ABOVE GROUND
(7)THE ERP OR EFFECTIVE RADIATED POWER OF THE TRANSMITTER
(8)THE SERVICE THE LICENSE WAS ISSUED FOR
(9)AND THE LEGAL NAME, ADDRESS, AND TELEPHONE OF THE LICENSEE

THE RECEIVER RECORDS LIST THE FOLLOWING INFORMATION:
(1)OPERATING FREQUENCY
(2)LATITUDE AND LONGITUDE OF THE RECEIVER
(3)THE TONE SQUELCH FREQUENCY USED (IF ANY)

THE MOBILE RECORDS LIST THE FOLLOWING INFORMATION:
(1)CALL SIGN
(2)NUMBER OF UNITS AUTHORIZED
(3)THE OUTPUT POWER OF THE MOBILES
(4)OPERATING FREQUENCY

IN SOME CASES A CALL SIGN WILL BE LISTED AS "KNEW". THIS INDICATES THERE IS AN APPLICATION PENDING WHICH MAY BE ISSUED ON THAT FREQUENCY. WHEN THE CALL SIGN IS KNEW SOME OF THE INFORMATION MAY NOT BE AVAILABLE SO THAT THE RECORDS WILL BE FILLED WITH @@@@@.

TONE SQUELCH FREQUENCY IS NOT LICENSED BY THE COMMISSION THEREFORE THE TONE SQUELCH RECORDS IN THIS SEARCH SHOULD NOT BE CONSIDERED AS COMPLETELY ACCURATE. THEY ARE ONLY WHAT THE LICENSE APPLICANTS HAVE FURNISHED TO THIS OFFICE.

IF THIS OFFICE CAN BE OF ANY FURTHER ASSISTANCE TO YOU DO NOT HESITATE TO CALL ON US.
YOURS TRULY

THE FOLLOWING TRANSMITTER RECORDS WERE FOUND IN THE SEARCH AREA

| FREQUENCY | NAME SORT FIELD | CALL SIGN | LATITUDE | LONGITUDE | TSF | ANTENNA HEIGHT | ERP | SERVICE |
|---|---|---|---|---|---|---|---|---|
| 158805000 | PERUPLILL | KJY703 | 41/19/41 | 89/ 7/35 | 151.4 | 68 | 84 | PL |

LEGAL NAME OF LICENSEE

CITY OF PERU, ILLINOIS

MAILING ADDRESS OF LICENSEE TELEPHONE NUMBER

CITY OF PERU, ILL.
1503 FOURTH ST.
PERU, ILL. 61354

| FREQUENCY | NAME SORT FIELD | CALL SIGN | LATITUDE | LONGITUDE | TSF | ANTENNA HEIGHT | ERP | SERVICE |
|---|---|---|---|---|---|---|---|---|
| 158805000 | ALSIPPLILL | KRT727 | 41/40/ 9 | 87/43/45 | | 62 | 21 | PL |

LEGAL NAME OF LICENSEE

VILLAGE OF ALSIP, ILLINOIS

MAILING ADDRESS OF LICENSEE TELEPHONE NUMBER

VILLAGE OF ALSIP, ILL.
45TH AVENUE & 123RD STREET
ALSIP, ILLINOIS 60658

3123891694

(For illustrative purposes, only two transmitter records are shown. The program retrieved 9 transmitter records.)

THESE ARE THE RECEIVER RECORDS WHICH WERE FOUND IN THE SEARCH AREA

| FREQUENCY | LATITUDE | LONGITUDE | TONE SQUELCH |
|---|---|---|---|
| 158805000 | 41/58/40 | 87/53/30 | 127.3 |
| 158805000 | 41/58/38 | 87/54/10 | 127.3 |
| 158805000 | 41/58/38 | 87/54/15 | 127.3 |

THE FOLLOWING MOBILE RECORDS WERE PULLED

| CALL SIGN | NUMBER OF UNITS | | OUTPUT POWER | FREQUENCY |
|---|---|---|---|---|
| | HAND HELD | LAND | | |
| KJY703 | 0 | 25 | 35 | 158805000 |
| KZ9706 | 0 | 29 | 7 | 158805000 |
| KK9808 | 31 | 65 | 45 | 158805000 |
| KXE603 | 4 | 25 | 8 | 158805000 |

THE DATABASE HAS BEEN CLOSED

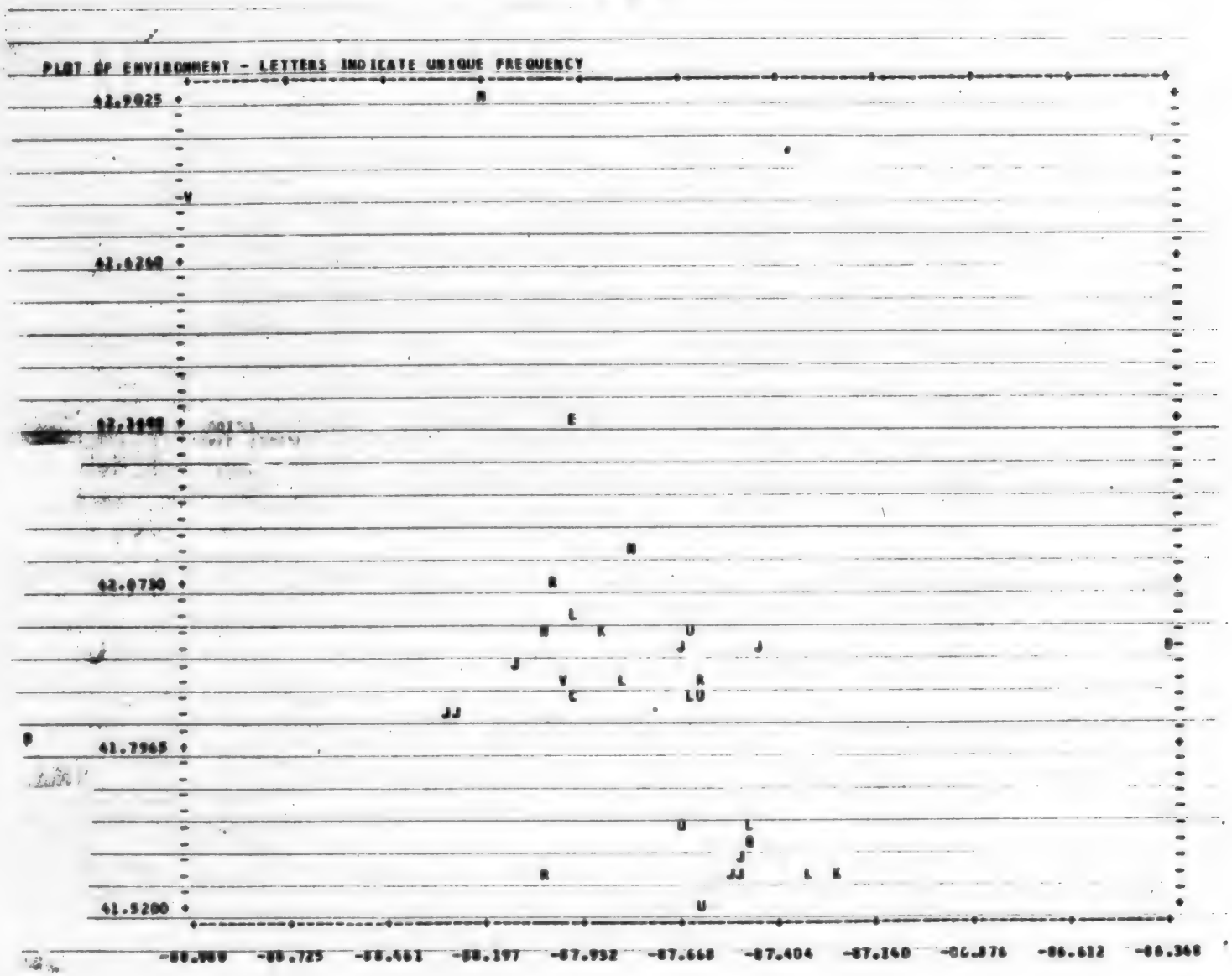
INPUT PARAMETERS
FREQUENCY = 461.91250 MHZ
DELTA FREQUENCY = .27500 MHZ
LATITUDE = 41.880 DEGREES
LONGITUDE = 87.600 DEGREES
DELTA DISTANCE = 100.0 MILES
TX TYPE RECORDS RETRIEVED
TIME USED SINCE LAST CALL TO CLOCK: 7.111 SECONDS CPU TIME -58508.248 SECONDS WALL CLOCK TIME

FOR DELTAF = .2750 MHZ, FREQ = 461.9125 MHZ, LT = 41.880 DEG, LN = 87.600 DEG, AND DELTAD = 100.0 MI
THERE WERE 126 TX 0 RX 61 TSC, AND 0 MOBTYPE RECORDS STORED
957 ACCESS(ES) TO DATA BASE

187 RECORDS GATHERED

| FREQUENCY (MHZ) | TYPE | LONGITUDE (DEGS) | LATITUDE (DEGS) | POWER (WATTS) | CLASS | LICENSE RD | LICENSEE ID | CALL SIGN | ANT HT (FT) | GRD ELEV (FT) | EST SIGNAL LEVEL (DB) | OCCUP LEVEL (DB) | NUM RDR | TONE SQULCH FREQ (HZ) | ANT GAIN (DB) | AZIM (DEGS) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 461.6500 | TX | 87.613 | 41.892 | 150.0 | FB2 | CIB731380029 | 9090 | KUA696 | 665 | 592 | -138.0 | 885.0 | 0 | 141.3 | 6.0 | 360 |
| | ADP: | 87.846 | 41.908 | | S1/S2: | 40.0/ 80.0 | | ORIEN: | 50.0 | | | | | | | |
| 461.6500 | TS | 87.613 | 41.892 | 150.0 | FB2 | CIB732390886 | 14388 | KTF321 | 665 | 592 | -138.0 | ***** | 0 | .0 | 6.0 | 360 |
| | ADP: | 87.613 | 41.892 | | S1/S2: | 80.0/ 80.0 | | ORIEN: | 90.0 | | | | | | | |
| 461.6500 | | 87.613 | 41.892 | 150.0 | | CIB732390971 | 13996 | KUJ254 | 665 | 592 | -138.0 | .0 | 0 | .0 | 6.0 | 360 |
| | ADP: | 87.846 | 41.908 | | S1/S2: | 40.0/ 80.0 | | ORIEN: | 50.0 | | | | | | | |
| 461.6500 | | 87.613 | 41.892 | 150.0 | | CIB732391509 | 10993 | KTG260 | 665 | 592 | -138.0 | .0 | 0 | 136.5 | 6.0 | 360 |
| | ADP: | 87.846 | 41.908 | | S1/S2: | 40.0/ 80.0 | | ORIEN: | 50.0 | | | | | | | |
| 461.6500 | | 87.613 | 41.892 | 150.0 | | CIB732391625 | 9515 | KGM397 | 665 | 592 | -138.0 | .0 | 0 | 186.2 | 6.0 | 360 |
| | ADP: | 87.846 | 41.908 | | S1/S2: | 40.0/ 80.0 | | ORIEN: | 50.0 | | | | | | | |
| 461.6500 | | 87.613 | 41.892 | 150.0 | | CIB732391723 | 9548 | KSP526 | 665 | 592 | -138.0 | .0 | 0 | 103.5 | 6.0 | 360 |
| | ADP: | 87.846 | 41.908 | | S1/S2: | 40.0/ 80.0 | | ORIEN: | 50.0 | | | | | | | |
| 461.6500 | | 87.613 | 41.892 | 150.0 | | CIB732392454 | 11150 | KFM691 | 665 | 592 | -138.0 | .0 | 0 | 91.5 | 6.0 | 360 |
| | ADP: | 87.846 | 41.908 | | S1/S2: | 40.0/ 80.0 | | ORIEN: | 50.0 | | | | | | | |
| 461.6500 | | 87.613 | 41.892 | 150.0 | | CIB732392492 | 11029 | KUA696 | 665 | 592 | -138.0 | .0 | 0 | 141.3 | 6.0 | 360 |
| | ADP: | 87.846 | 41.908 | | S1/S2: | 40.0/ 80.0 | | ORIEN: | 50.0 | | | | | | | |
| 461.6500 | | 87.613 | 41.892 | 150.0 | | CIB732392540 | 11212 | KSR350 | 665 | 592 | -138.0 | .0 | 0 | 127.3 | 6.0 | 360 |
| | ADP: | 87.846 | 41.908 | | S1/S2: | 40.0/ 80.0 | | ORIEN: | 50.0 | | | | | | | |
| 461.6500 | | 87.613 | 41.892 | 150.0 | | CIB742900017 | 25472 | KWY334 | 665 | 592 | -138.0 | .0 | 0 | .0 | 6.0 | 360 |
| | ADP: | 87.846 | 41.908 | | S1/S2: | 40.0/ 80.0 | | ORIEN: | 50.0 | | | | | | | |

EDR Plot


PLOT OF ENVIRONMENT - LETTERS INDICATE UNIQUE FREQUENCY
42.9025
42.6260
42.3495
42.0730
41.7965
41.5200
-88.989
-88.725
-88.461
-88.197
-87.932
-87.668
-87.404
-87.140
-86.876
-86.612
-86.348

SPECIAL RETRIEVAL/CORRELATION PROGRAM OUTPUT

***** ANALYSIS ON FREQUENCY: 471.0625 MHZ

WITH 6 CO-CHANNEL TRANSMITTERS AND 131 ADJACENT CHANNEL TRANSMITTERS

| THRESHOLD LEVELS | CO-CHANNEL SIGNALS ABOVE THRESHOLD | ADJACENT CHANNEL SIGNALS ABOVE THRESHOLD | CO-CHANNEL ON-CHANNEL MOBILES | CO-CHANNEL ASSOCIATED MOBILES | ADJACENT CHANNEL ON-CHANNEL MOBILES | ADJACENT CHANNEL ASSOCIATED MOBILES |
|---|---|---|---|---|---|---|
| -140.0 | 6 | 1 | 0 | 0 | 0 | 0 |

CO-CHANNEL CALL SIGN/LICENSE :
KUV927 /CIB731500127 KQH450 /CIB731500133 KVK305 /CIB732140008 KUH256 /CIB733320063 KZZ291 /CIB741690026
KW3471 /CIB741000087

ADJACENT CHANNEL CALL SIGN/LICENSE :
KEY622 /CIB731580006

***** ANALYSIS ON FREQUENCY: 471.0875 MHZ

WITH 6 CO-CHANNEL TRANSMITTERS AND 131 ADJACENT CHANNEL TRANSMITTERS

| THRESHOLD LEVELS | CO-CHANNEL SIGNALS ABOVE THRESHOLD | ADJACENT CHANNEL SIGNALS ABOVE THRESHOLD | CO-CHANNEL ON-CHANNEL MOBILES | CO-CHANNEL ASSOCIATED MOBILES | ADJACENT CHANNEL ON-CHANNEL MOBILES | ADJACENT CHANNEL ASSOCIATED MOBILES |
|---|---|---|---|---|---|---|
| -140.0 | 6 | 3 | 0 | 0 | 0 | 0 |

CO-CHANNEL CALL SIGN/LICENSE :
KVU508 /CIB739600002 KVK935 /CIB740320004 KWE721 /CIB740740042 KWH774 /CIB741010009 KS1900 /CIB741210037
KW0769 /CIB741040028

ADJACENT CHANNEL CALL SIGN/LICENSE :
KUV927 /CIB731500127 KQH450 /CIB731500133 KEY622 /CIB731580006

***** ANALYSIS ON FREQUENCY: 471.9125 MHZ

WITH 3 CO-CHANNEL TRANSMITTERS AND 134 ADJACENT CHANNEL TRANSMITTERS

| THRESHOLD LEVELS | CO-CHANNEL SIGNALS ABOVE THRESHOLD | ADJACENT CHANNEL SIGNALS ABOVE THRESHOLD | CO-CHANNEL ON-CHANNEL MOBILES | CO-CHANNEL ASSOCIATED MOBILES | ADJACENT CHANNEL ON-CHANNEL MOBILES | ADJACENT CHANNEL ASSOCIATED MOBILES |
|---|---|---|---|---|---|---|
| -140.0 | 3 | 1 | 0 | 0 | 0 | 0 |

CO-CHANNEL CALL SIGN/LICENSE :
KZZ760 /CIB731900131 KCL391 /CIB750520018 KDV631 /CIB750520021

DATABASE LISTING IN NAME SORT FIELD SEQUENCE

DATE 040477

| LICENSE NUMBER | NAME SORT FIELD | FREQUENCY | CALL SIGN | EXPIRA DATE | LATITUDE | LONGITUDE | T U | MOBILES AUTH | LICENSEE ID | TONE SQ | PURP APPN |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CIB762160099 | AAAALOCKSMITH | 463.6000 | KBA222 | 810804 | 41/04/14 | 85/07/10 | MO | 8 | 3460601 | | B |
| CIB762160101 | AAAALOCKSMITH | 468.6000 | KBA222 | 810804 | 41/04/14 | 85/07/10 | MO | 8 | 3460601 | | B |
| CIB762160100 | AAAALOCKSMITH | 463.6000 | KBA222 | 810804 | 41/04/14 | 85/07/10 | TX | 0 | 3460601 | | B |
| CIB762390059 | AAAAMBSVC | 154.5400 | KTF826 | 810827 | 40/28/40 | 88/59/30 | MO | 10 | 3503601 | 94.8 | D |
| CIB762390060 | AAAAMBSVC | 154.5400 | KTF826 | 810827 | 40/28/40 | 88/59/30 | TX | 0 | 3503601 | 94.8 | D |
| CIB762390029 | AAAAMBSVCOFCOOKCNTYI | 475.9875 | KY7459 | 810827 | 41/52/36 | 87/52/30 | MO | 2 | 3489601 | 131.8 | B |
| CIB762390027 | AAAAMBSVCOFCOOKCNTYI | 472.9875 | KBJ365 | 810827 | 41/52/44 | 87/38/10 | TX | 0 | 3489601 | 131.8 | B |
| CIB762390028 | AAAAMBSVCOFCOOKCNTYI | 475.9875 | WBY374 | 810827 | 41/52/51 | 87/45/18 | TX | 0 | 3489601 | 131.8 | B |
| CIB731500180 | AAABUSSVCINC | 35.1200 | KZZ732 | 780530 | 40/07/04 | 85/36/51 | MO | 4 | 1214601 | 146.2 | B |
| CIB731500181 | AAABUSSVCINC | 35.1200 | KZZ732 | 780530 | 40/07/04 | 85/36/51 | TX | 0 | 1214601 | 146.2 | |
| CLX732360159 | AAACABCOOFALSIPILL | 152.3300 | KJK644 | 770824 | 41/40/48 | 87/43/11 | TX | 0 | 2901801 | 110.9 | D |
| CIB732500062 | AAACHEMICALTOILETSIN | 468.3500 | KQ6074 | 780116 | 41/59/30 | 87/48/45 | MO | 10 | 1392201 | | B |
| CIB732330203 | AAACHEMICALTOILETSIN | 468.3500 | WPT97 | 780116 | 41/51/24 | 87/38/25 | TX | 0 | 1392201 | | B |
| CIB732330202 | AAACHEMICALTOILETSIN | 463.3500 | KUR809 | 780116 | 41/53/55 | 87/37/23 | TX | 0 | 1392201 | | B |
| CIS742880015 | AAADISPOSALSYSTEMSIN | 43.4800 | KVW915 | 791015 | 42/26/36 | 89/00/57 | MO | 7 | 2020202 | | D |
| CIS742880016 | AAADISPOSALSYSTEMSIN | 43.4800 | KVW915 | 791015 | 42/26/36 | 89/00/57 | TX | 0 | 2020202 | | D |
| CCA742560003 | AAADRIVESHAFTCO | 467.5500 | KAA9718 | 790913 | 41/59/21 | 87/48/33 | MO | 3 | 2470801 | | B |
| CCA742560001 | AAADRIVESHAFTCO | 462.5500 | KAA9720 | 790913 | 41/53/08 | 87/37/15 | TX | 0 | 2470801 | | B |
| CCA742560002 | AAADRIVESHAFTCO | 467.5500 | KAA9719 | 790913 | 41/57/26 | 87/41/20 | TX | 0 | 2470801 | | B |
| CIB770200038 | AAAHEATINGSVCINC | 464.8500 | KQX291 | 820120 | 39/51/24 | 85/59/01 | MO | 8 | 3675101 | 162.2 | B |
| CIB770200039 | AAAHEATINGSVCINC | 464.8500 | KQX291 | 820120 | 39/51/24 | 85/59/01 | TX | 0 | 3675101 | 162.2 | B |
| CIB762650038 | AAAHEATING&SHEETMETA | 151.7150 | KBX292 | 810922 | 40/17/20 | 86/30/00 | MO | 10 | 3537901 | | B |
| CIB762650039 | AAAHEATING&SHEETMETA | 151.7150 | KBX292 | 810922 | 40/17/20 | 86/30/00 | TX | 0 | 3537901 | | B |
| CIB770380036 | AAALOCK&KEY | 43.0000 | KUH501 | 820207 | 42/14/15 | 87/46/11 | MO | 8 | 1395501 | 136.5 | D |
| CIB770380037 | AAALOCK&KEY | 43.0000 | KUH501 | 820207 | 42/14/15 | 87/46/11 | TX | 0 | 1395501 | 136.5 | D |
| CPS760630023 | AAAMBCO | 468.1750 | KW8916 | 810304 | 40/34/32 | 89/36/57 | MO | 2 | 3228501 | | B |
| CPS760630016 | AAAMBCO | 468.0000 | KW8916 | 810304 | 40/34/32 | 89/36/57 | MO | 2 | 3228501 | | B |
| CPS760630015 | AAAMBCO | 155.3400 | KW8916 | 810304 | 40/34/32 | 89/36/57 | MO | 10 | 3228501 | | B |
| CPS760630020 | AAAMBCO | 468.1000 | KW8916 | 810304 | 40/34/32 | 89/36/57 | MO | 2 | 3228501 | | B |
| CPS760630022 | AAAMBCO | 468.1500 | KW8916 | 810304 | 40/34/32 | 89/36/57 | MO | 2 | 3228501 | | B |
| CPS760630017 | AAAMBCO | 468.0250 | KW8916 | 810304 | 40/34/32 | 89/36/57 | MO | 2 | 3228501 | | B |
| CPS760630018 | AAAMBCO | 468.0500 | KW8916 | 810304 | 40/34/32 | 89/36/57 | MO | 2 | 3228501 | | B |
| CPS760630019 | AAAMBCO | 468.0750 | KW8916 | 810304 | 40/34/32 | 89/36/57 | MO | 2 | 3228501 | | B |
| CPS760630021 | AAAMBCO | 468.1250 | KW8916 | 810304 | 40/34/32 | 89/36/57 | MO | 2 | 3228501 | | B |
| CPS741340085 | AAAMBINC | 155.2200 | KZ9765 | 790514 | 40/34/31 | 89/38/42 | MO | 6 | 2271501 | 103.5 | B |
| CPS741340086 | AAAMBINC | 155.2200 | KWK500 | 790514 | 40/34/31 | 89/38/42 | TX | 0 | 2271502 | | B |
| CIB733020026 | AAAMITTMAN&SON | 27.4500 | KVM601 | 781029 | 41/53/20 | 88/07/39 | MO | 5 | 1610701 | | B |
| CIB733020027 | AAAMITTMAN&SON | 27.4500 | KVM601 | 781029 | 41/53/20 | 88/07/39 | TX | 0 | 1610701 | | B |
| CIB770310032 | AAAMOSEMERGENCYROAD& | 468.7000 | KL2076 | 820131 | 41/52/36 | 87/52/30 | MO | 3 | 3686401 | 94.8 | B |
| CIB770310030 | AAAMOSEMERGENCYROAD& | 463.7000 | KRP638 | 820131 | 41/52/44 | 87/38/10 | TX | 0 | 3686401 | 94.8 | B |
| CIB770310031 | AAAMOSEMERGENCYROAD& | 468.7000 | WCG374 | 820131 | 42/00/24 | 87/37/46 | TX | 0 | 3686401 | 94.8 | B |
| CLA770040071 | AAAMOTORCLUBOFIOWA | 150.9050 | KJR384 | 820104 | 41/32/16 | 90/35/12 | MO | 12 | 3677601 | | D |
| CLA770040072 | AAAMOTORCLUBOFIOWA | 150.9050 | KJR384 | 820104 | 41/32/16 | 90/35/12 | TX | 0 | 3677601 | | D |
| CIB752900032 | AAAOVERHEADDOOR&SUPP | 468.7500 | KM9606 | 801017 | 43/02/56 | 88/03/48 | MO | 5 | 1772502 | 136.5 | B |
| CIB752900030 | AAAOVERHEADDOOR&SUPP | 463.7500 | KRG492 | 801017 | 42/57/50 | 88/04/30 | TX | 0 | 1772502 | 136.5 | D |
| CIB752900031 | AAAOVERHEADDOOR&SUPP | 468.7500 | WBE59 | 801017 | 42/54/19 | 87/51/34 | TX | 0 | 1772502 | 136.5 | D |
| CIB740710026 | AAAPOWERINC | 31.2000 | KJK451 | 790312 | 41/55/05 | 87/59/22 | MO | 8 | 2087001 | | C |
| CIB740710027 | AAAPOWERINC | 31.2000 | KJK451 | 790312 | 41/55/05 | 87/59/22 | TX | 0 | 2087001 | | C |
| CIB770210009 | AAASECURITYCOINC | 468.8250 | KJ8575 | 820121 | 42/21/24 | 88/14/11 | MO | 5 | 2411802 | 192.8 | B |
| CIB770210008 | AAASECURITYCOINC | 468.8250 | WCG365 | 820121 | 42/14/46 | 88/19/42 | TX | 0 | 2411802 | 192.8 | B |

5. DATA BASE EXTRACT

APPENDIX B

INTERIM PROGRESS REPORT ON SPECTRUM MONITORING

PART 1

The Commission has found that good information on channel utilization is essential to prudent management of the spectrum. The complex nature of this utilization in the land mobile services, and its magnitude, require extensive analysis of the raw data that the monitoring program collects. While the Commission continues its analysis, however, there are many useful things about channel utilization that we now know. It is the purpose of this appendix to illustrate a very small part of this useful information. Our reason for doing this to begin a process of familiarization with monitoring data and its many useful aspects. We anticipate that interested parties will address their comments to the utility of monitoring data as an important adjunct to traditional methods of frequency engineering.

The Chicago Office has conducted two principal monitoring programs. First has been the "production" monitoring program. This program results in spectrum occupancy data which is used by the automatic frequency assignment program (AFAM). Second, and perhaps more important, the Chicago staff has been monitoring for the past year a group of selected channels in a special "Long-Term Monitoring Project".

*Production Monitoring*

Production monitoring to support the frequency selection program has been conducted at 56 sites (urban and rural) within a 100 mile radius of Chicago. Monitoring sites were selected to fit a grid pattern designed to provide comprehensive data over areas where monitoring was to be conducted. A site spacing of five miles enables the monitoring system to record any use of a channel by typical base stations and their associated mobiles. This five mile grid size was adopted for use in urban areas where it was thought desirable to have the most detailed information. Outside of these urban areas, where there is less density of users, the grid size was set at 25 miles. Actual site selection was affected by availability of parking space for the monitoring vans. Much use has been made of governmental lands and buildings such as state parks and post offices.

Each of the 56 monitoring sites is revisited periodically to update utilization information. The Regional staff believed it was necessary to have more timely information in areas heavily populated by existing users and potential users. Accordingly, visits to urban sites were scheduled for at least four times per year while sites in non-urban areas were visited on a yearly basis. The production data collection was performed at antenna heights of 12 to 25 feet.

The scanning procedure used in the production sampling scheme has been to divide the land mobile spectrum into blocks of contiguous channels and to scan each for five minutes. The entire land mobile spectrum is examined by sequencing through the scan blocks then repeating the process. The Commission has used two similar monitoring vans to collect the usage data. One van, fabricated by Fairchild Electrometrics Corporation of Amsterdam, New York, is able to sample the entire land mobile spectrum in 136 minutes utilizing 21 scan blocks with a maximum of 146 frequencies in a given block. The other two vans, put together by Standford Research Institute (SRI) of Palo Alto, California, have a greater sampling speed than the Fairchild van so that they can sample the same spectrum in about 78 minutes with a maximum of 250 frequencies in the scan blocks.

The output of the monitoring equipment is a computer tape containing administrative information (such as location, date and times of day) and, for each frequency, a recording of the signal level each time the frequency is sampled during the scan (normally more than 600 times per five-minute scan period). This raw data tape is then processed by the computer at the Regional office. The tape reduction process is accomplished in several steps. First, the raw tape is run through a pre-reduction analysis to determine the validity of the raw data, the amount of monitoring accomplished, and to obtain information about the monitor site characteristics such as the ambient noise level. The raw data tape is then read, the tape reduction program applied, channel utilization information is derived and then stored on a disc medium for more convenient access. The tape reduction produces an unsorted utilization data file which is then sorted into a file ordered by frequency. Each frequency record in this file contains the following information for each five-minute scan period:

1. Frequency
2. Year
3. Month
4. Day
5. Hour
6. Minute
7. Site ID
8. Ground Elevation
9. Antenna Support TYPE
10. Antenna Height
11. Structure Height
12. Noise Level
13. Equipment Status
14. No. of Impulse Noise Samples
15. No. of Intermodulation Samples
16. No. of Adjacent Channel Samples
17. No. of Valid Samples
18. Maximum Signal Level
19. Minimum Signal Level
20. Average Signal Level
21. Occupancy due to samples greater than −140 DBW
22. Greater than −134 DBW
23. Greater than −128 DBW
24. Greater than −122 DBW
25. Greater than −116 DBW
26. Greater than −110 DBW
27. Greater than −104 DBW
28. Average Message Length
29. Standard Deviation of Message Length
30. Average Message Gap Length
31. Standard Deviation of Gap Length
32. Number of Messages
33. Number of Transmissions
34. Standard Deviation of Transmissions, per Message
35. Number of Intra-Message Gaps
36. Average Transmission Length
37. Standard Deviation of Transmission Length
38. Average Intra-Message Gap Length
39. Standard Deviation of Intra-Message Gap Length

The frequency ordered utilization data is then run through a program to produce a summary file which is used as the on-line production monitoring data base file consisting of the following information for each frequency (See Appendix C for printouts of this information.):

1. Latitude
2. Longitude
3. Receiver Antenna Height Designator
4. Frequency
5. Quarter (of the year)
6. 90th Percentile Occupancy
7. 50th Percentile Occupancy
8. 10th Percentile Occupancy
9. Mean Occupancy
10. Peak Five-Minute Occupancy
11. Waiting Time (Using 90th Percentile Occupancy)
12. Waiting Time (Using 50th Percentile Occupancy)
13. Number of Five-Minute Samples taken in Quarter
14. Waiting Time (Using Mean Occupancy)
15. Waiting Time (Using Peak Five-Minute Occupancy)
16. Average Occupancy due to each station in the environment assigned this frequency
17. Year

*Long-Term Monitoring Project*

A special "Long-Term Monitoring Project" was initiated for the purpose of establishing confidence bounds on the production sampling scheme. Statistical knowledge gained on hourly, daily and monthly variations in channel utilization obtained from the project will be useful in determining the number of days needed to spend at a monitoring site and the frequency of visits.

For this special project, equipment was removed from one of the SRI vans and installed in the Regional Office connected to a roof-top antenna with a height of 58 feet. A group of 246 channels from each of the three major land mobile bands was selected as channels to be monitored. Special usage channels, low-power and mobile only frequencies were eliminated so that for each radio service the normal two-way channels would be scanned. Each block of 246 frequencies was scanned almost continuously over each day for one week. The equipment recorded 10 to 11 five-minute samples in each hour of the monitoring day compared to one five-minute sample per hour for production monitoring. This special monitoring was conducted from late May, 1976, through August, 1976, alternating weekly between the 25, 150, and 450 MHz bands. A voluminous amount of data has been recorded in this project. We have initiated a number of analysis projects. These analyses will yield considerable knowledge about spectrum usage by licensees in the Chicago area. We will publish periodic reports on the results of these analyses as they are concluded. Some significant preliminary results and examples of the types of data available are presented hereafter.

All of the data included in the Figures of this Report have been calculated from raw data tapes recorded in the "Long-Term Monitoring Project". In essence, the project consisted of special monitoring of 246 channels from each of the bands 35–50 MHz, 150–160 MHz and 450–470 MHz. The selected frequencies in each band were monitored continuously each day for one week alternating the bands monitored from week to week. In this project, each frequency was monitored continuously yielding 50–55 minutes out of each hour whereas in the production monitoring scheme, each channel is normally monitored for five minutes out of each hour. Although data was obtained for all three of the major land mobile bands, we have included, for illustrative purposes, only data from the 150 MHz band.

TABLE 1.—*Summaries of 150–160 MHz Frequencies Monitored*

| Service: | Number of Frequencies Monitored |
|---|---|
| Business | 13 |
| Special industrial | 20 |
| Telephone maintenance | 1 |
| Power | 33 |
| Auto emergency | 15 |
| Taxicab | 4 |
| Fire | 19 |
| Highway maintenance | 25 |
| Local government | 35 |
| Forestry-conservation | 40 |
| Police | 34 |
| Special emergency | 7 |

Care should be taken when interpreting the following graphs. The data was taken from only one monitoring site; it is presented for illustrative purposes only; the comparisons made are relative not absolute; and questions remain as to the statistical variations of the measured parameters. In addition, the following should be taken into consideration:

(1) Unless indicated otherwise, all data shown was taken from tapes recorded during the week of May 24–28, 1976.

(2) The data was collected at the Park Ridge, Illinois, site of the Chicago Regional Office, in the northwest suburbs 15 miles from the center of downtown Chicago.

(3) At a receiving antenna height of 56 feet, the practical radius of coverage ranges from 10 to 50 miles depending on the antenna heights of transmitting stations—10 miles for low-power mobiles and 50 miles for base stations having antennas 1,000 feet above ground. The median radius of coverage is about 22 miles for typical base stations. This means we could receive stations in most of the Chicago metropolitan area plus the northern and western suburbs.

For the purpose of this paper, the following definitions apply:

(1) *Five-Minute Occupancy.*—Percentage of time is a five minute period a signal is found on a channel by the monitor receiver.

(2) *Peak Five-Minute Occupancy.*—The maximum five-minute occupancy for any given day (or other monitoring period).

(3) *Hourly Occupancy.*—The average of all five-minute occupancies measured in a given hour.

(4) *Peak Hour Occupancy.*—The maximum hourly occupancy for a particular day.

(5) *Daily Average Occupancy.*—The average of all five-minute occupancies measured over the monitoring day.

THE FIGURES

*Figure 1.*—This figure shows the relationship between five-minute occupancies and the hourly occupancy and indicates that the maximum (or peak) five-minute occupancy does not have to occur in the peak hour.

*Figure 2.*—This figure compares the weekly mean value of Peak Hour Occupancy and Average five-minute occupancy for the week with the maximum five-minute occupancy occurring in the week for 13 Business frequencies.

*Figure 3.*—For three frequencies in the Power Radio Service, this figure indicates the manner in which the weekly mean of the Peak Hour Occupancy varies over the year.

The dates of the relative weeks are:

1—June 30–July 3, 1975
2—July 14–18, 1975
6—August 4–8, 1975
15—October 8–10, 1975
35—February 23–27, 1976
37—March 10–12, 1976
39—March 23–26, 1976
45—May 3–5, 1976
48—May 24–28, 1976
52—June 24–25, 1976

*Figure 4.*—This figure is a graphical representation of the relationship between measured occupancy and calculated waiting time. Waiting time is the time a user has to wait on a channel before he can transmit a message. It is calculated as an average waiting time in the peak period of channel usage. The curve is plotted for average message lengths of 30, 20 and 10 seconds. At the 40% occupancy point, the waiting time to use the channel would be 54 seconds, 36 seconds and 18 seconds for channels having average message lengths of 30, 20 and 10 seconds, respectively.

*Figures 5 through 15.*—These graphs show the weekly mean value of Peak Hour Occupancy for each of the 150 MHz frequencies monitored in this project. The graphs may be used to make a relative comparison between frequencies available to a particular radio service and between frequencies available to different services. Only data for the week of May 24–28, 1976, is presented.

*Figures 16 through 19.*—These figures are copies of actual printouts obtained from the DAYTAB (Daily Tabulation) computer routine that calculates the occupancy parameters we have plotted in the preceding figures. Two frequencies from the Business Radio Service are used as examples. For each frequency, the first page of the two-page printout contains the following information.

(1) First column—The month/day/year of the monitoring day.

(2) Next 24 columns—The heading of each column is the hour of day using 24-hour clock. For each day, the first row in these columns contains the hourly occupancy for the hour beginning with the time heading for the column. The second row contains the number of five-minute scan blocks monitored within the particular hours. The last two rows under these columns are (1) the average hourly occupancy for the week and (2) the total number of five-minute samples used to calculate the average hourly occupancy. (Only those hours with six or more five-minute samples were included in the calculation.)

(3) 26th column—The first figure in this column, labelled PK, is the maximum hourly occupancy or "peak hour occupancy" (for each day). The second figure is the maximum five-minute occupancy or "peak five-minute occupancy" for the day.

(4) 27th column—The first figure in this column labelled MP, is the hour of the day in which the peak hour occupancy occurs. The second figure is the hour of the day in which the peak five-minute occupancy occurs.

(5) 28th column—The first figure in this column, labelled AV, is the average of all the hourly occupancies for the day. The second figure is the average of all the five-minute occupancies measured in the day. Either figure can be referred to as the "daily average occupancy".

(6) 29th column—The column, labelled 90, contains the 90th percentile occupancy for the day. 90th percentile occupancy means that 10% of the five-minute occupancies recorded in the day are greater than the specified value while 90% of the five-minute occupancies are equal to or less than the specified value.

(7) 30th column—The first figure in this column, labelled A/P, is the ratio of daily average occupancy to the peak hour occupancy. The second figure is the ratio of daily average occupancy to the peak five-minute occupancy.

(8) Weekly Summary—This summary, printed underneath the foregoing, should be self explanatory. It lists the minimum, maximum and average values of the specified parameters.

The second page of the two-page printout is a plot of the hourly occupancies listed in columns headed 00 to 23 on the first page. The symbol "1" represents the hourly occupancy levels for the first day of the monitoring week. The symbol "2" represents the hourly occupancy levels for the second day, and so forth. The asterisk represents the average hourly occupancy levels for the week. If data points for two or more days coincide, the symbol for the latest day is shown.

*Results of Analyses to Date*

The following are the results and conclusions of analyses of spectrum usage data derived from the long-term and production monitoring programs. They summarize a number of different staff studies which have yet to be publicly released.

With respect to the monitoring system and measurement methods, we find that:

1. In measuring Average Occupancy from production data, the maximum measurement error is within ±8 Percent Occupancy and slightly higher for 90th Percentile Occupancy (within ±14 Percent Occupancy).

2. The relative measurement error is larger for low occupancy channels than for high occupancy channels.

3. Measurement error decreases with increased sampling during a given time period.

4. The optimum scanning/sampling method is a compromise between the production sampling scheme and the long-term type of continuous monitoring:

a. Allowing an increased number of channels to be scanned in a given period.

b. Maintaining the confidence level at 95% ±3 Percent Occupancy.

5. To accurately describe the usage on a channel within a given hour, at least three five-minute samples per hour are required.

From the analyses conducted to date on the utilization of frequencies in the Chicago area, we have found that:

1. There is no reasonable correlation between spectrum utilization data and the number of base stations, mobiles and licensees authorized in the area. (See Part 2 for details of a specific study.)

2. Below 450 MHz, there is an increase in measured utilization with an increase in monitor receiver antenna height.

3. Most frequencies exhibit a standard deviation within ±10 Percent Occupancy in Peak and Average usage from day-to-day.

4. 90th Percentile Occupancy and Average Occupancy tend to be normally distributed.

5. For low occupancy channels, the distribution of five-minute occupancy samples taken consecutively on a land mobile channel for a 12 hour period (about 144 samples) usually is not similar to any common statistical distributions. For high occupancy channels, the distribution of these samples tend toward a normal distribution.

6. The distribution of 90% occupancy samples taken by the monitor is usually asymmetric with respect to the 90% occupancy value determined by use of all of the five-minute samples for a day. Usually about ⅔ of the 90% occupancy distribution falls below the full day value giving a like probability that the 90% occupancy value determined by the monitor will be lower than the true 90% occupancy value.

7. The monitor average sampling distribution is usually symmetric about the average

value determined from all of the days samples. There is an equal probability that the measured average monitor occupancy will be either high or low.

*Optimum Loading Level*

The Commission is faced with the question of how to determine whether a channel is loaded to saturation, to an optimum level, or to a level which permits additional users. One apporach taken by the Commission has been to adopt mobile loading standards in the 470–512 MHz band and 800 MHz band. Part 2 of this report deals with the relationship between mobile loading standards and actual on-the-air usage measured by our monitoring equipment.

After further analysis, we expect to be able to determine the optimum loading level and the level of usage at which saturation occurs. For the purpose of discussion, the saturation level is defined as the level of channel usage at which the addition of another user cannot be tolerated by existing users on a channel; and the optimum loading level is defined as the preferred level of channel usage at which additional licensees should not be authorized to use a given channel on a time-sharing basis in the same geographic area.

From the plot of Waiting Time vs. Transmission Occupancy (Figure 4) and the graphs showing channel usage by the Business and Taxicab Radio Services (Figures 13 and 15–19), it appears that an occupancy figure in the 40%–60% range could be considered as an optimum loading level for those two services. The further development of this concept will depend on a variety of factors involving the ways in which channels are used by various kinds of users. Obviously there are different levels of acceptability for different priorities of use. These are subjects for comment in the current proceeding, but will be considered extensively in the future proceedings before loading levels are established.

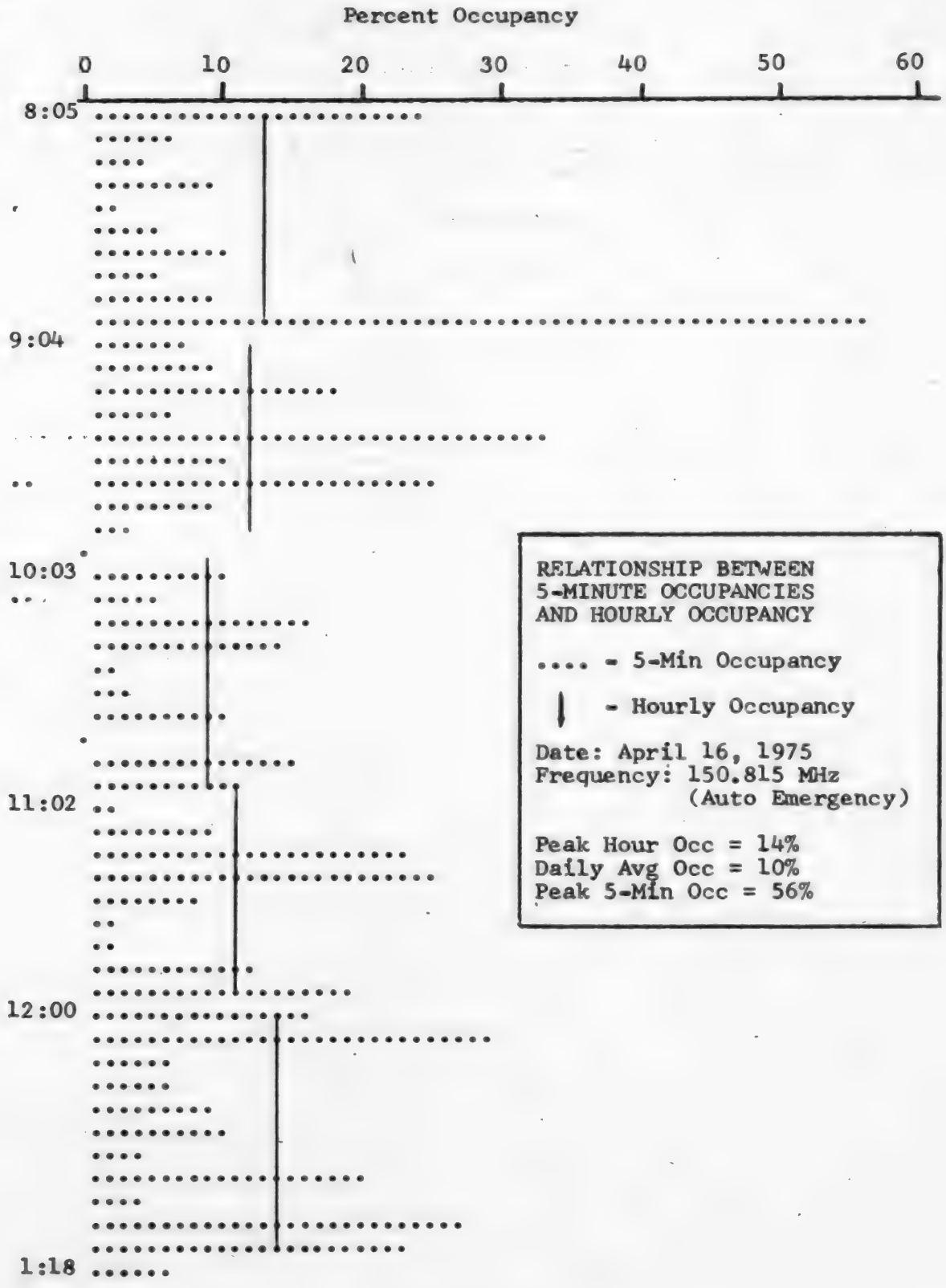
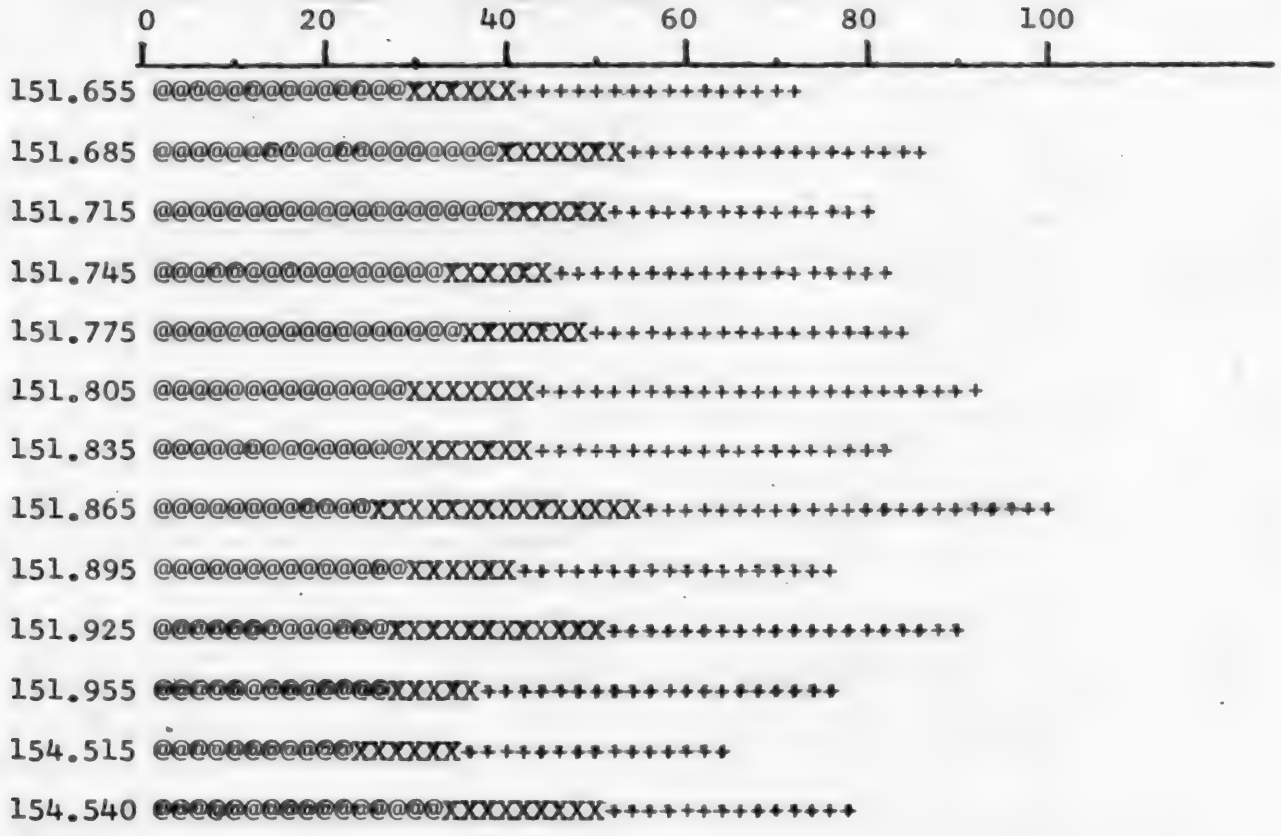

Percent Occupancy
0
10
20
30
40
50
60
8:05
9:04
10:03
11:02
12:00
1:18
RELATIONSHIP BETWEEN
5-MINUTE OCCUPANCIES
AND HOURLY OCCUPANCY
.... - 5-Min Occupancy
- Hourly Occupancy
Date: April 16, 1975
Frequency: 150.815 MHz
(Auto Emergency)
Peak Hour Occ = 14%
Daily Avg Occ = 10%
Peak 5-Min Occ = 56%

FIGURE 1

BUSINESS RADIO SERVICE

Percent Occupancy




@ = Average 5-Minute Occupancy for the week (or Mean Daily Average)

X = Weekly Mean of the Peak Hour Occupancy

\+ = Maximum 5-Minute Occupancy for the week

FIGURE 2

Weekly Mean of Peak Hour Occupancy
over a 52-week period from June 30, 1975
to June 24, 1976

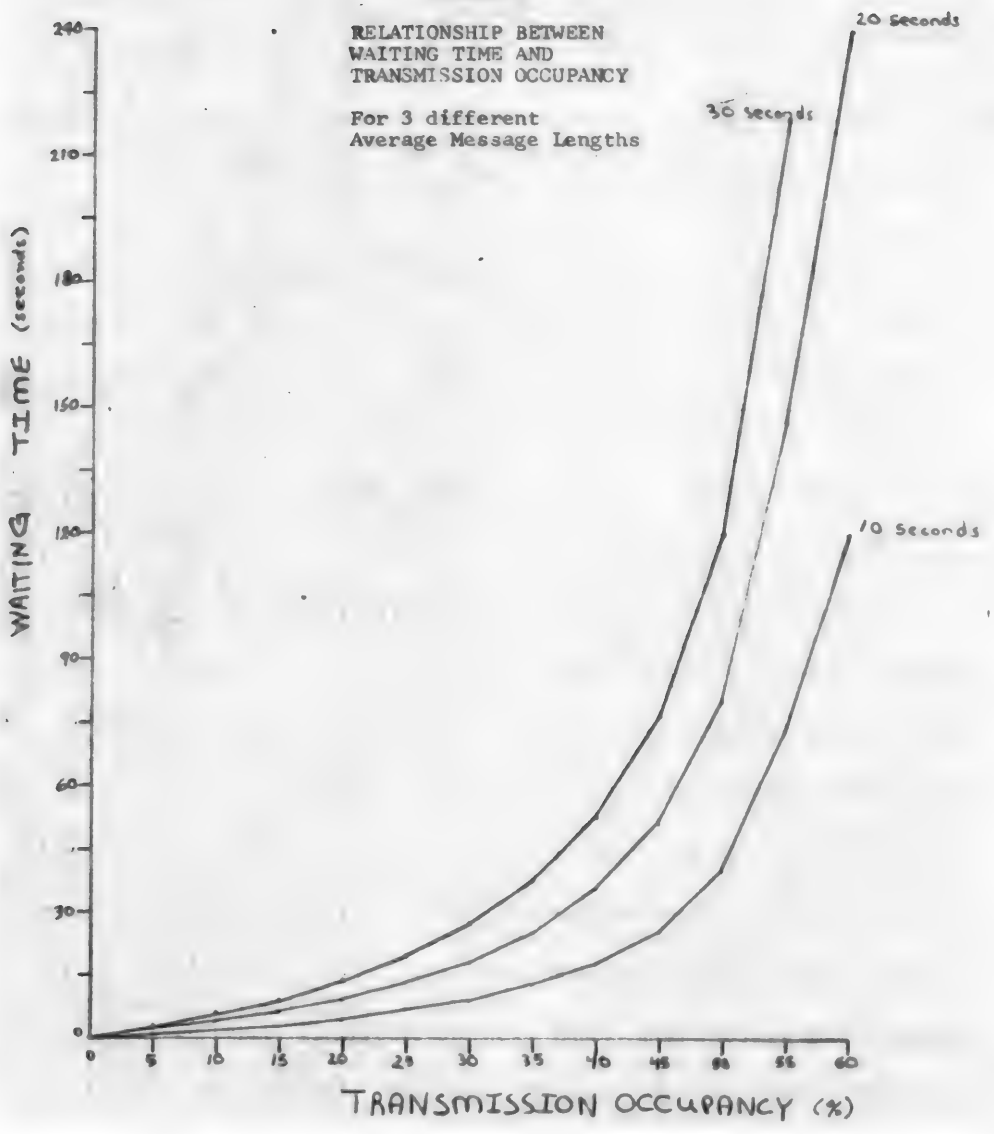
(Power Radio Service)

FIGURE 3

FIGURE 4

RELATIONSHIP BETWEEN
WAITING TIME AND
TRANSMISSION OCCUPANCY

For 3 different
Average Message Lengths



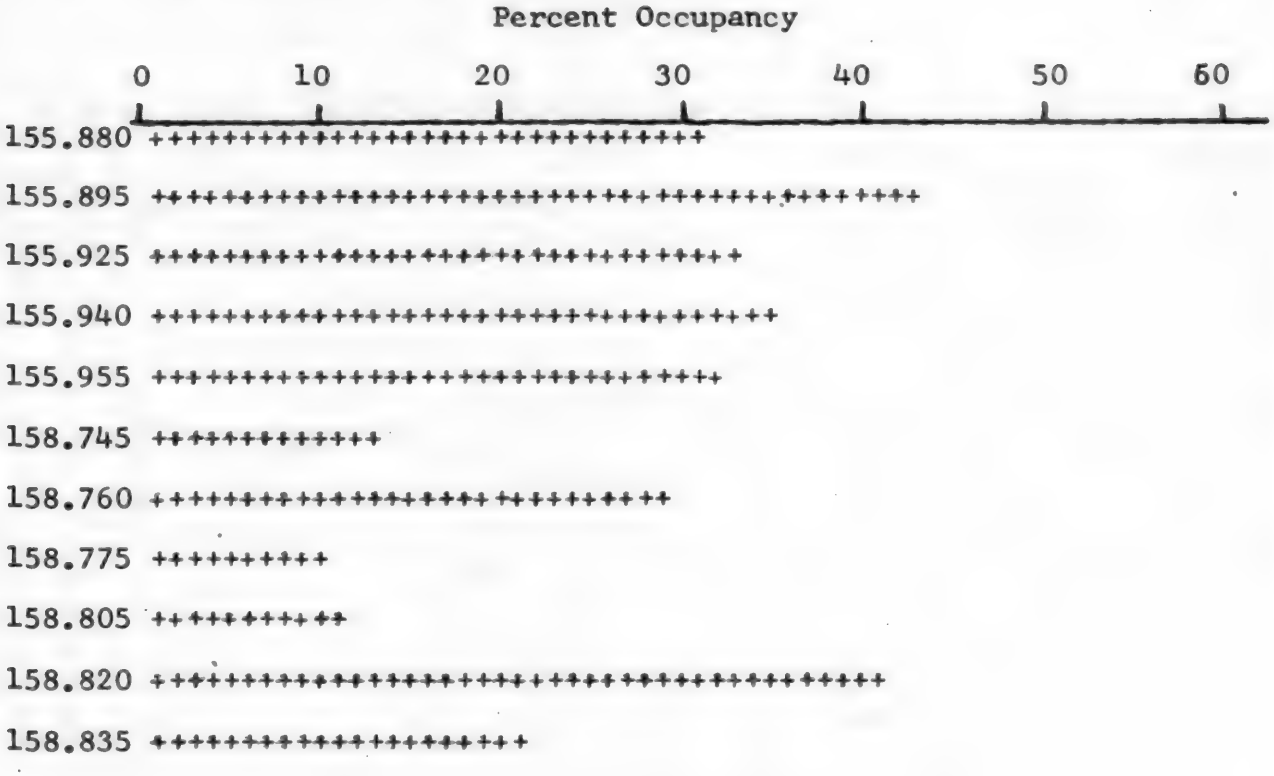
LOCAL GOVERNMENT RADIO SERVICE

Percent Occupancy

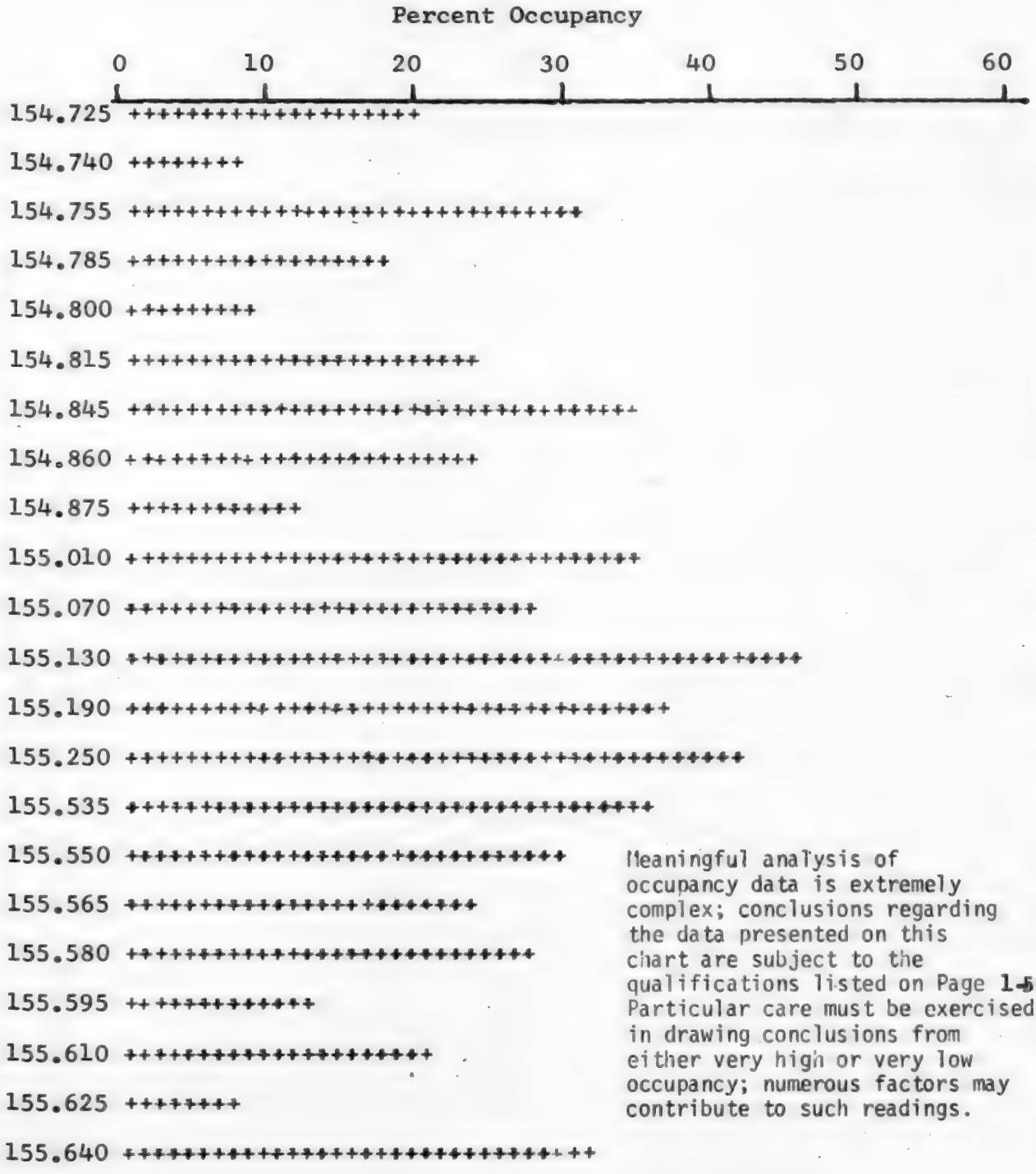
Meaningful analysis of occupancy data is extremely complex; conclusions regarding the data presented on this chart are subject to the qualifications listed on Page 1-5 Particular care must be exercised in drawing conclusions from either very high or very low occupancy; numerous factors may contribute to such readings.

FIGURE 5

Local Government (continued)



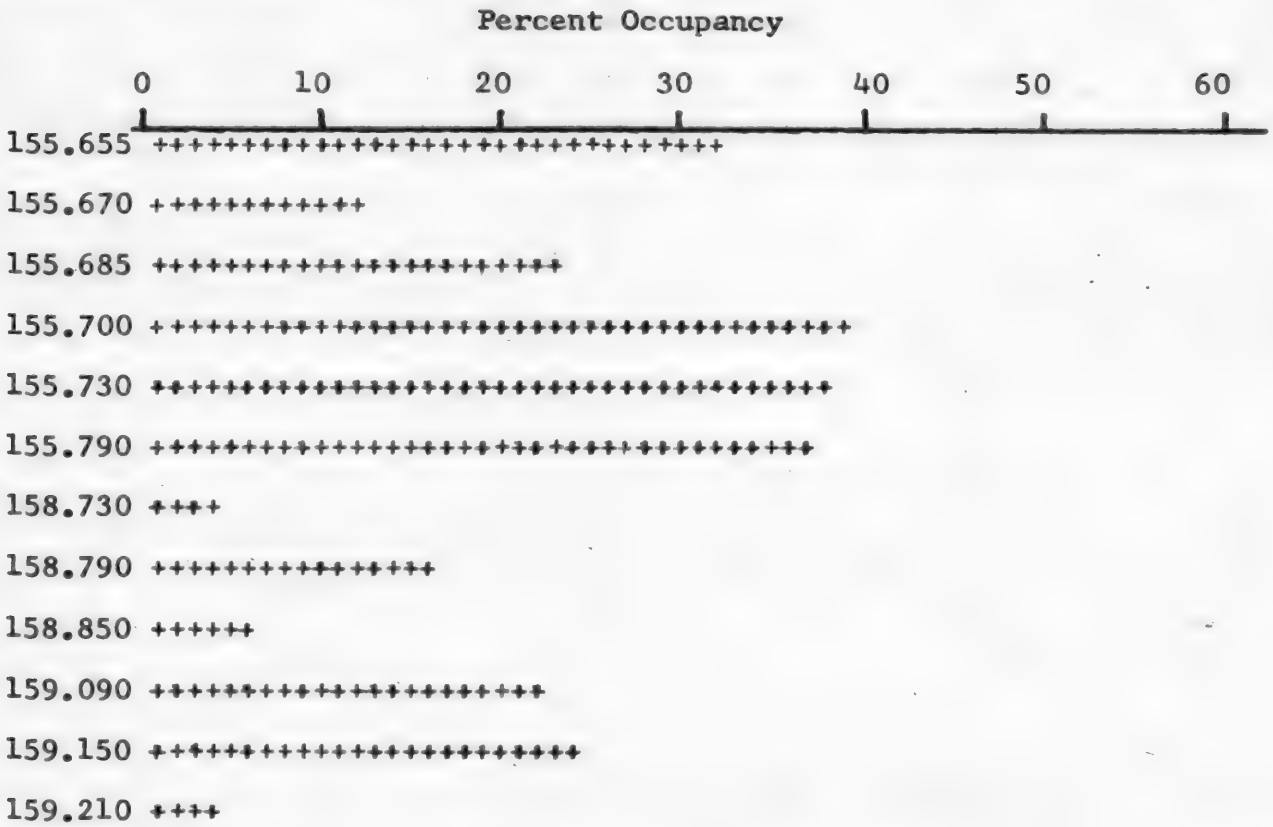
POLICE RADIO SERVICE




Meaningful analysis of occupancy data is extremely complex; conclusions regarding the data presented on this chart are subject to the qualifications listed on Page 1-5 Particular care must be exercised in drawing conclusions from either very high or very low occupancy; numerous factors may contribute to such readings.

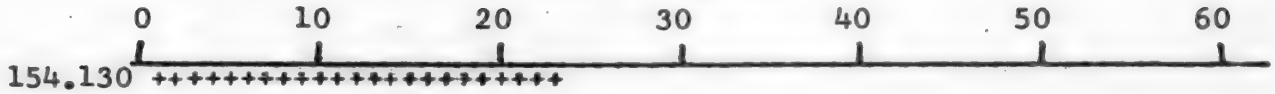
FIGURE 6

Police (continued)



FIRE RADIO SERVICE

Percent Occupancy




154.130 ++++++++++++++++++++++++

154.145 +++

154.160 +++++++

154.175 +++

154.190 ++++++++

154.205 ++++++++++

154.220 ++++++++++++

154.235 ++++++

154.250 ++++++++++

154.310 ++++++++++

154.325 ++

154.340 ++++++++++++++

154.355 +++

154.370 ++++++++++++

154.385 +++

154.400 +++++++++++++++

154.415 ++++++++++++

154.430 ++++++++++

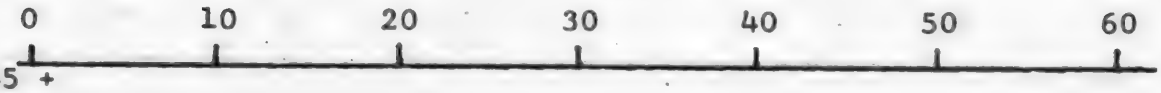
154.445 +++++++

Meaningful analysis of occupancy data is extremely complex; conclusions regarding the data presented on this chart are subject to the qualifications listed on Page 1-5 Particular care must be exercised in drawing conclusions from either very high or very low occupancy; numerous factors may contribute to such readings.

FIGURE 7

FORESTRY-CONSERVATION RADIO SERVICE

Percent Occupancy

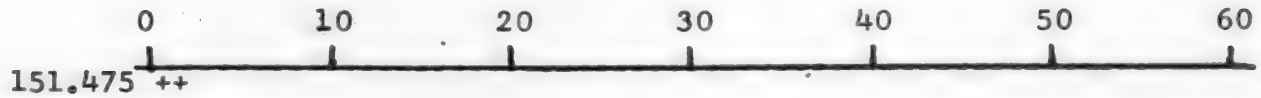



151.145 +
151.160 +
151.175 ++++
151.190 +
151.205 ++++
151.220 +++
151.235 ++++
151.250 ++++
151.265 +
151.280 +
151.295 ++++
151.310 +++
151.325 +++++
151.340 +
151.355 +
151.370 ++
151.385 ++
151.400 +++
151.415 +++
151.430 +
151.445 +
151.460 ++

Meaningful analysis of occupancy data is extremely complex; conclusions regarding the data presented on this chart are subject to the qualifications listed on Page 1-5 Particular care must be exercised in drawing conclusions from either very high or very low occupancy; numerous factors may contribute to such readings.

FIGURE 8

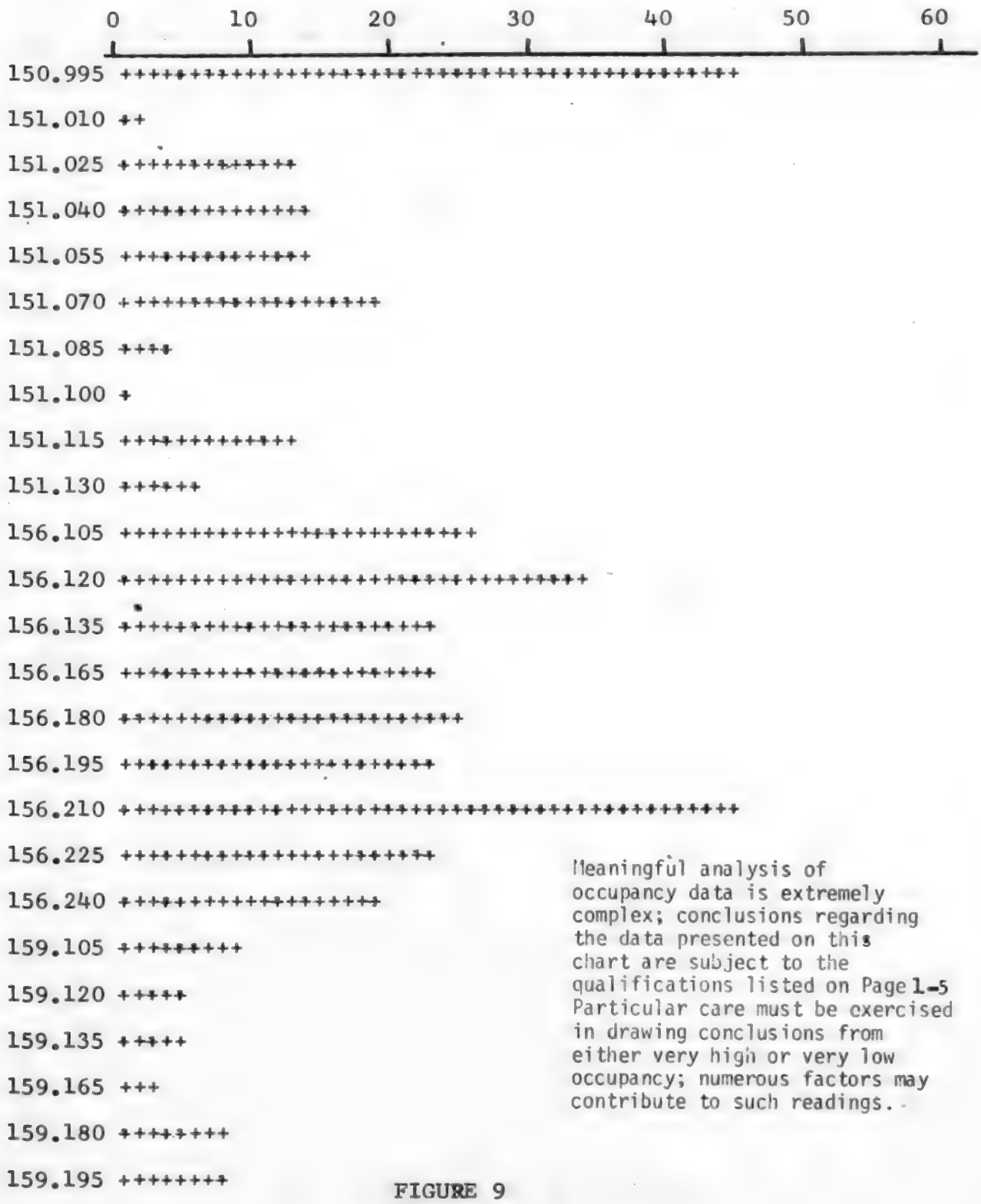
Forestry-Conservation (continued)




151.475 ++
159.225 ++++++
159.240 ++
159.255 ++
159.270 ++
159.300 +++
159.315 +++
159.330 ++
159.345 ++
159.360 ++
159.375 ++
159.390 ++
159.405 +++
159.420 ++++++++++
159.435 ++
159.450 +++
159.465 ++++

HIGHWAY MAINTENANCE RADIO SERVICE

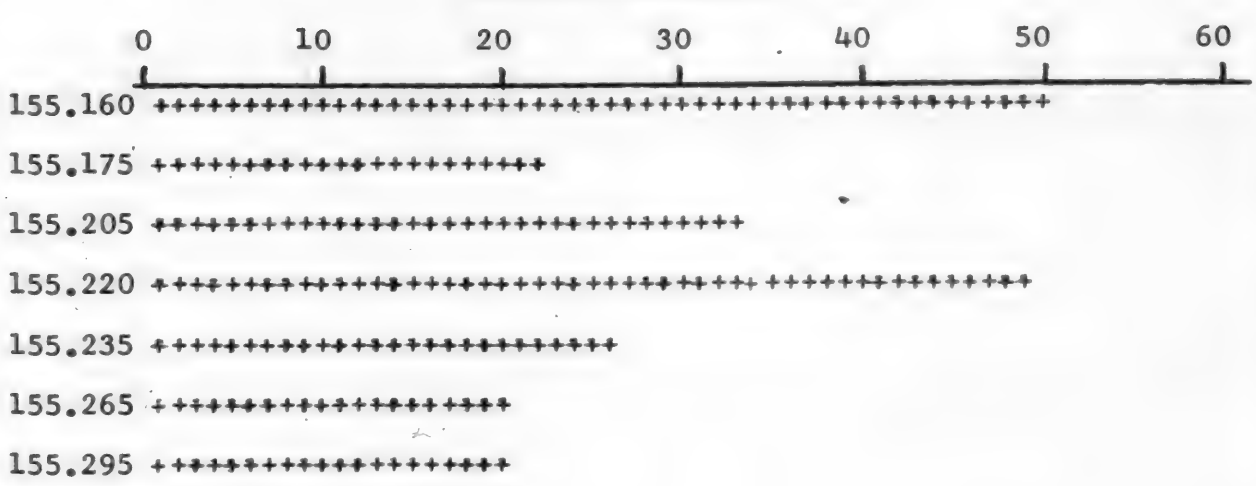
Percent Occupancy




Meaningful analysis of occupancy data is extremely complex; conclusions regarding the data presented on this chart are subject to the qualifications listed on Page 1-5 Particular care must be exercised in drawing conclusions from either very high or very low occupancy; numerous factors may contribute to such readings.

FIGURE 9

SPECIAL EMERGENCY RADIO SERVICE




Meaningful analysis of occupancy data is extremely complex; conclusions regarding the data presented on this chart are subject to the qualifications listed on Page 1-5 Particular care must be exercised in drawing conclusions from either very high or very low occupancy; numerous factors may contribute to such readings.

FIGURE 10

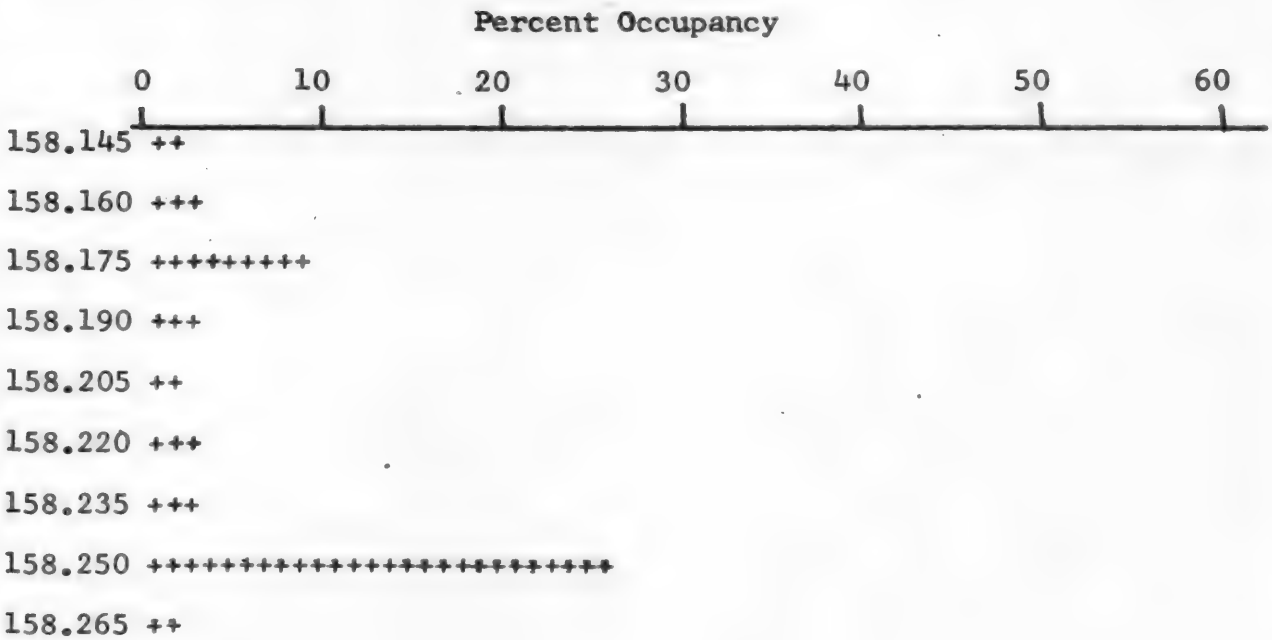
POWER RADIO SERVICE

Percent Occupancy

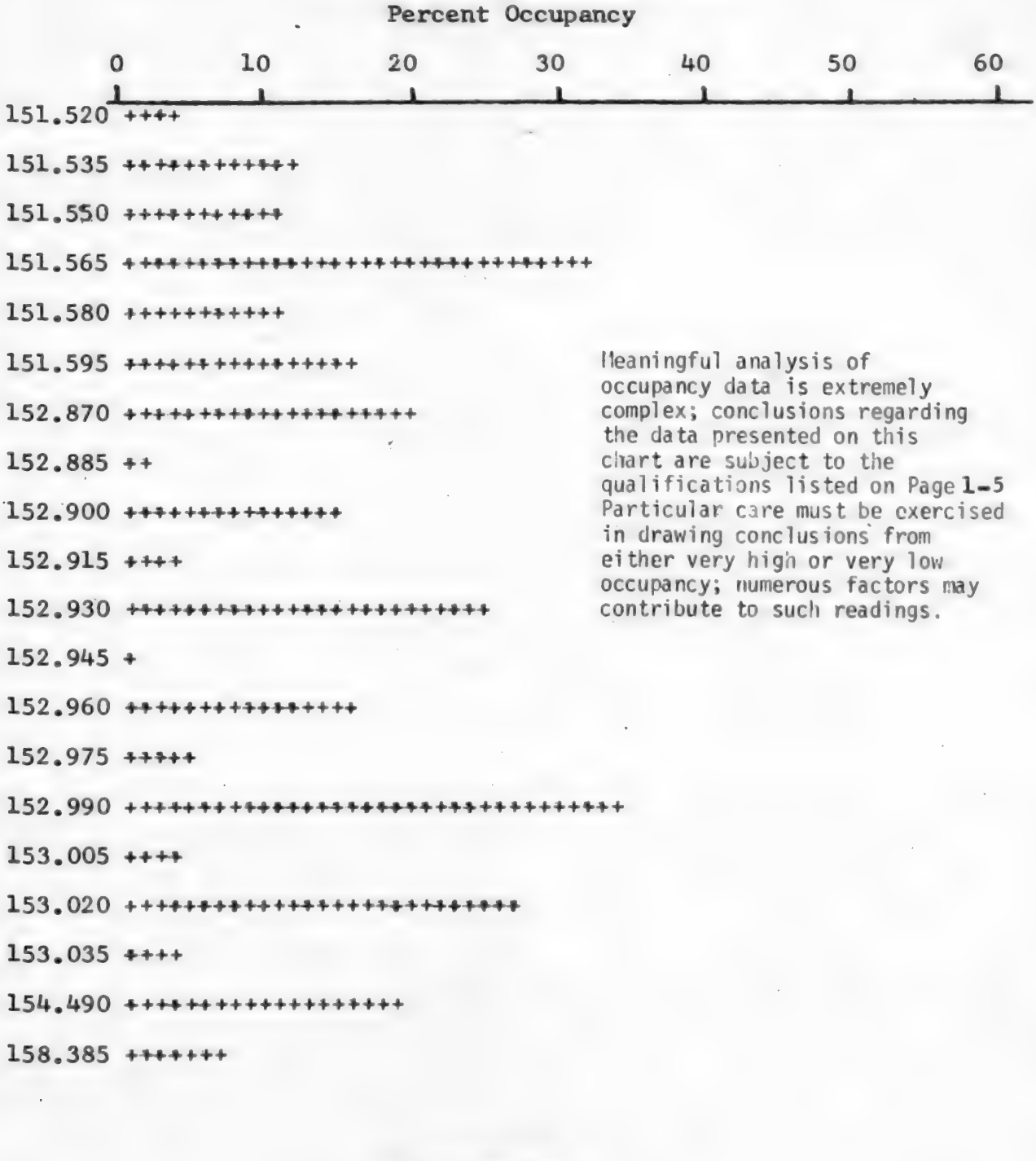
Meaningful analysis of occupancy data is extremely complex; conclusions regarding the data presented on this chart are subject to the qualifications listed on Page1-5 Particular care must be exercised in drawing conclusions from either very high or very low occupancy; numerous factors may contribute to such readings.

FIGURE 11

Power (continued)



SPECIAL INDUSTRIAL RADIO SERVICE

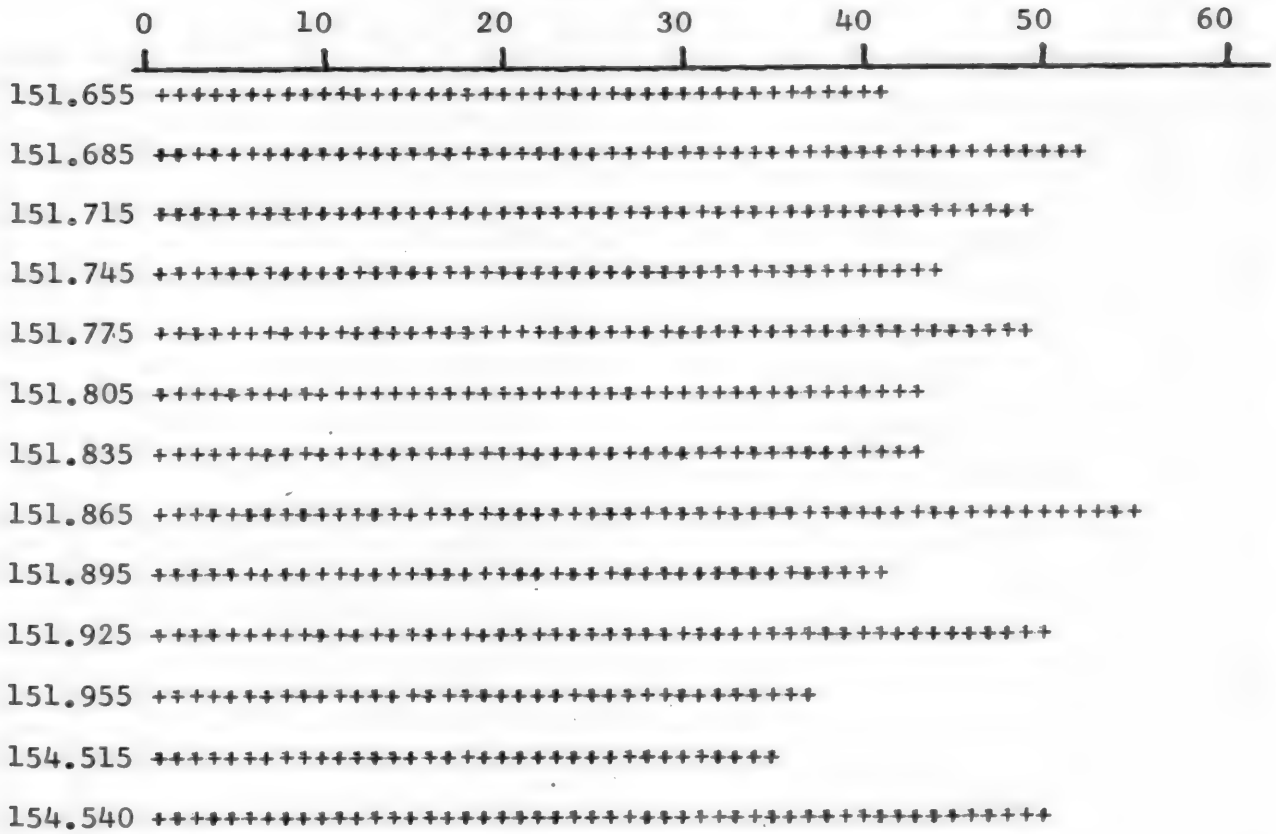



Meaningful analysis of occupancy data is extremely complex; conclusions regarding the data presented on this chart are subject to the qualifications listed on Page 1-5 Particular care must be exercised in drawing conclusions from either very high or very low occupancy; numerous factors may contribute to such readings.

FIGURE 12

BUSINESS RADIO SERVICE

Percent Occupancy

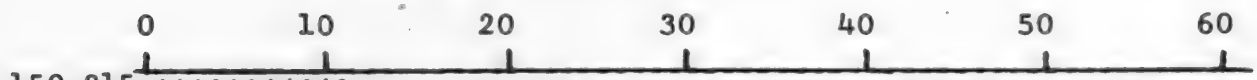



Meaningful analysis of occupancy data is extremely complex; conclusions regarding the data presented on this chart are subject to the qualifications listed on Page 1-5. Particular care must be exercised in drawing conclusions from either very high or very low occupancy; numerous factors may contribute to such readings.

FIGURE 13

AUTOMOBILE EMERGENCY RADIO SERVICE

Percent Occupancy




150.815 ++++++++++

150.830 +++

150.845 ++++

150.860 ++++

150.875 ++++++++++

150.890 ++++++

150.905 +++++++++++++

150.920 +

150.935 +

150.950 +++++

150.965 +

157.470 ++++++++++

157.485 ++++++++

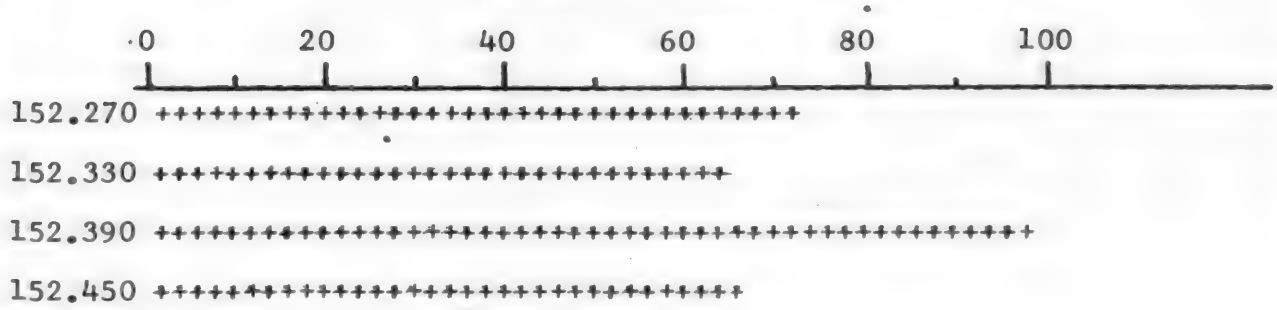
157.500 +++++++++

157.515 ++

Meaningful analysis of occupancy data is extremely complex; conclusions regarding the data presented on this chart are subject to the qualifications listed on Page 1-5 Particular care must be exercised in drawing conclusions from either very high or very low occupancy; numerous factors may contribute to such readings.

FIGURE 14

TAXICAB RADIO SERVICE




Meaningful analysis of occupancy data is extremely complex; conclusions regarding the data presented on this chart are subject to the qualifications listed on Page 1-5 Particular care must be exercised in drawing conclusions from either very high or very low occupancy; numerous factors may contribute to such readings.

FIGURE 15

DAILY OCCUPANCY TABULATION FOR FREQUENCY: 151.8650

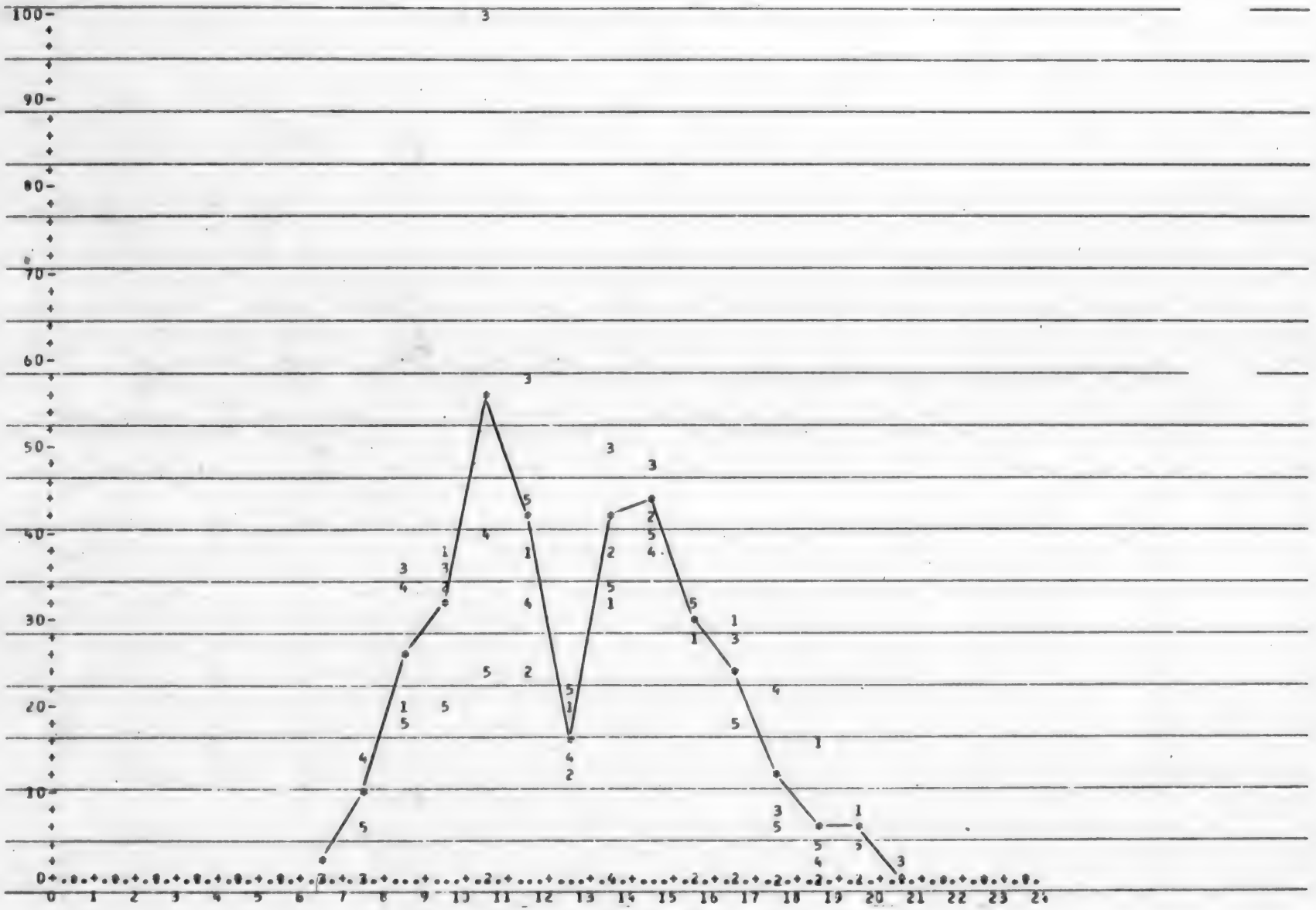
| DATE | 00 | 01 | 02 | 03 | 04 | 05 | 06 | 07 | 08 | 09 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | PK | MP | AV | 90 | A/P |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 05/24/76 | 00 | 00 | 00 | 00 | 00 | 00 | 02 | 09 | 20 | 37 | 55 | 37 | 19 | 31 | 48 | 28 | 30 | 12 | 16 | 07 | 00 | 00 | 00 | 00 | 55 | 10 | 25 | | .45 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 11 | 10 | 11 | 10 | 11 | 10 | 5 | 11 | 10 | 11 | 11 | 10 | 9 | 0 | 0 | 0 | 0 | 86 | 11 | 25 | 63 | .29 |
| 05/25/76 | 00 | 00 | 00 | 00 | 00 | 00 | 01 | 09 | 25 | 33 | 00 | 23 | 11 | 38 | 41 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 38 | 13 | 20 | | .53 |
| | 0 | 0 | 0 | 0 | 0 | 2 | 11 | 10 | 11 | 11 | 0 | 1 | 10 | 11 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 91 | 13 | 20 | 48 | .25 |
| 05/26/76 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 36 | 35 | ** | 58 | 15 | 49 | 47 | 30 | 27 | 08 | 03 | 03 | 01 | 00 | 00 | 00 | ** | 10 | 34 | | .34 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 9 | 10 | 11 | 10 | 11 | 11 | 10 | 10 | 10 | 11 | 11 | 10 | 1 | 0 | 0 | 0 | ** | 11 | 34 | ** | .34 |
| 05/27/76 | 00 | 00 | 00 | 00 | 00 | 00 | 01 | 13 | 34 | 31 | 40 | 32 | 13 | 00 | 37 | 29 | 23 | 21 | 02 | 06 | 00 | 00 | 00 | 00 | 40 | 10 | 22 | | .55 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 11 | 10 | 11 | 10 | 11 | 10 | 0 | 9 | 10 | 11 | 10 | 11 | 10 | 1 | 0 | 0 | 0 | 91 | 14 | 21 | 46 | .23 |
| 05/28/76 | 00 | 00 | 00 | 00 | 00 | 00 | 02 | 05 | 18 | 19 | 23 | 43 | 22 | 34 | 39 | 32 | 18 | 05 | 03 | 03 | 00 | 00 | 00 | 00 | 43 | 11 | 19 | | .44 |
| | 0 | 0 | 0 | 0 | 0 | 2 | 10 | 10 | 11 | 10 | 11 | 7 | 9 | 10 | 8 | 10 | 11 | 10 | 11 | 11 | 0 | 0 | 0 | 0 | 84 | 13 | 18 | 43 | .21 |
| | 00 | 00 | 00 | 00 | 00 | 00 | 01 | 09 | 26 | 31 | 55 | 42 | 16 | 41 | 43 | 30 | 24 | 11 | 06 | 05 | 00 | 00 | 00 | 00 | | | | | |
| | 0 | 0 | 0 | 0 | 0 | 0 | 41 | 42 | 51 | 53 | 42 | 39 | 50 | 32 | 38 | 40 | 43 | 42 | 43 | 40 | 0 | 0 | 0 | 0 | | | | | |

WEEKLY SUMMARY:

| AVERAGE HOUR | | | PEAK HOUR | | | AVRG 5 MINUTES | | | 90 PERCENTILE | | | PEAK 5 MINUTES | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MIN | MAX | AVG | MIN | MAX | AVG | MIN | MAX | AVG | MIN | MAX | AVG | MIN | MAX | AVG |
| 19 | 34 | 24 | 38 | ** | 55 | 18 | 34 | 24 | 43 | ** | 60 | 81 | ** | 88 |

FIGURE 16

FIGURE 17 - OCCUPANCY vs TIME



DAILY OCCUPANCY TABULATION FOR FREQUENCY: 151.9550

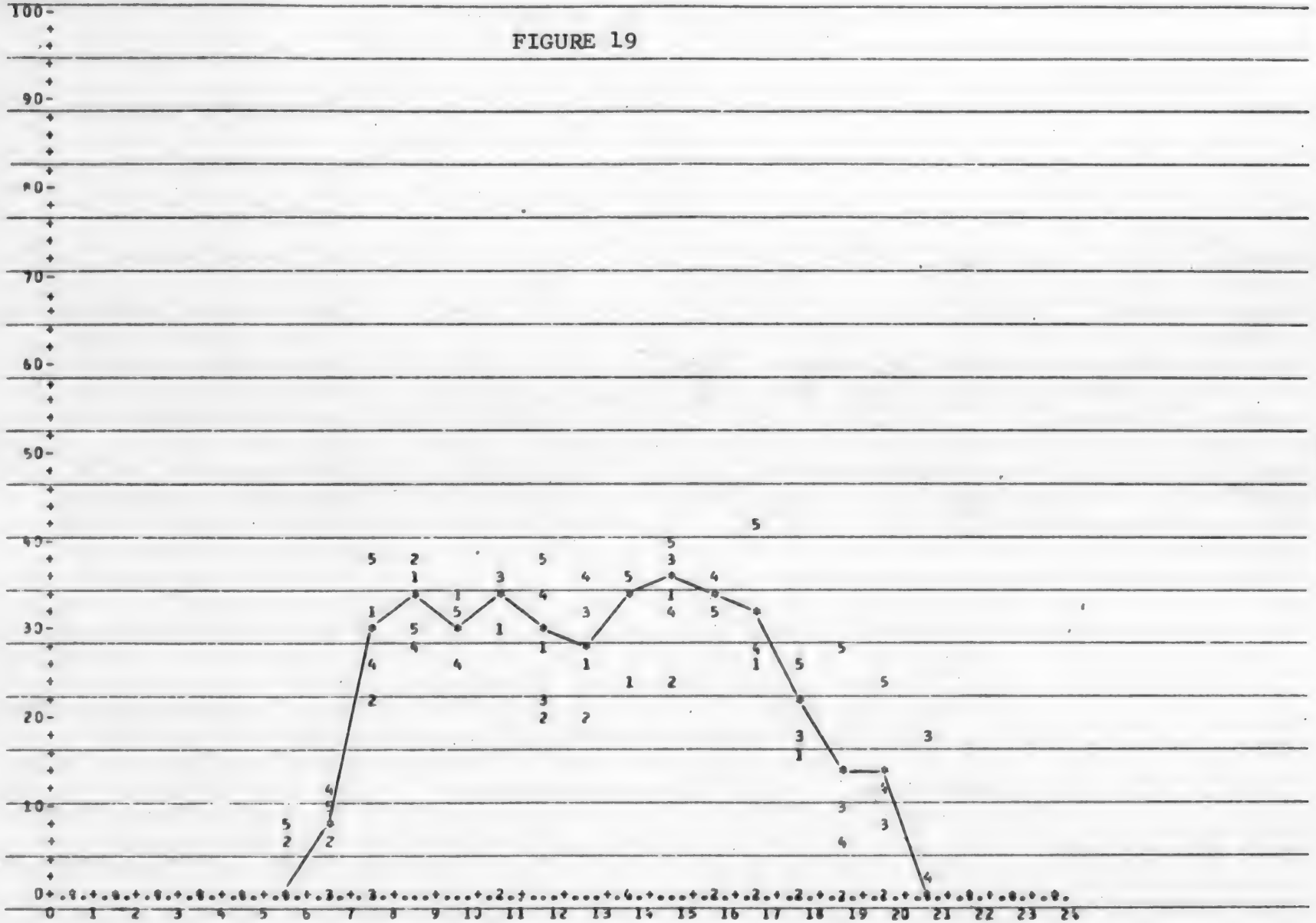
| DATE | 00 | 01 | 02 | 03 | 04 | 05 | 06 | 07 | 08 | 09 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | PK | MP | AV | 90 | A/P |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 05/24/76 | 00 | 00 | 00 | 00 | 00 | 00 | 05 | 32 | 35 | 34 | 30 | 27 | 25 | 23 | 33 | 32 | 25 | 15 | 13 | 14 | 00 | 00 | 00 | 00 | 35 | 08 | 25 | | .71 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 11 | 10 | 11 | 10 | 11 | 10 | 5 | 11 | 10 | 11 | 11 | 10 | 9 | 0 | 0 | 0 | 0 | 73 | 9 | 25 | 44 | .34 |
| 05/25/76 | 00 | 00 | 00 | 00 | 00 | 06 | 05 | 22 | 37 | 25 | 00 | 20 | 19 | 34 | 24 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 37 | 08 | 24 | | .65 |
| | 0 | 0 | 0 | 0 | 0 | 2 | 11 | 10 | 11 | 11 | 0 | 1 | 10 | 11 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 60 | 13 | 23 | 42 | .38 |
| 05/26/76 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 34 | 30 | 35 | 21 | 32 | 34 | 37 | 35 | 31 | 18 | 39 | 07 | 18 | 00 | 00 | 00 | 37 | 14 | 27 | | .73 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 9 | 10 | 11 | 10 | 11 | 11 | 10 | 10 | 10 | 11 | 11 | 10 | 1 | 0 | 0 | 0 | 65 | 14 | 27 | 50 | .42 |
| 05/27/76 | 00 | 00 | 00 | 00 | 00 | 00 | 12 | 25 | 27 | 26 | 36 | 33 | 35 | 00 | 32 | 35 | 28 | 26 | 06 | 12 | 01 | 00 | 00 | 00 | 35 | 15 | 25 | | .71 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 11 | 10 | 11 | 10 | 11 | 10 | 0 | 9 | 10 | 11 | 10 | 11 | 10 | 1 | 0 | 0 | 0 | 68 | 10 | 25 | 45 | .37 |
| 05/28/76 | 00 | 00 | 00 | 00 | 00 | 07 | 10 | 37 | 30 | 32 | 34 | 38 | 27 | 35 | 39 | 32 | 41 | 25 | 28 | 23 | 00 | 00 | 00 | 00 | 41 | 16 | 31 | | .76 |
| | 0 | 0 | 0 | 0 | 0 | 2 | 10 | 10 | 11 | 10 | 11 | 7 | 9 | 10 | 8 | 10 | 11 | 10 | 11 | 11 | 0 | 0 | 0 | 0 | 76 | 14 | 30 | 51 | .39 |
| | 00 | 00 | 00 | 00 | 00 | 00 | 08 | 29 | 33 | 29 | 33 | 29 | 28 | 34 | 35 | 34 | 31 | 21 | 14 | 14 | 00 | 00 | 00 | 00 | | | | | |
| | 0 | 0 | 0 | 0 | 0 | 0 | 41 | 42 | 51 | 53 | 42 | 39 | 50 | 32 | 38 | 40 | 43 | 42 | 43 | 40 | 0 | 0 | 0 | 0 | | | | | |

WEEKLY SUMMARY:

| AVERAGE HOUR | | | PEAK HOUR | | | AVRG 5 MINUTES | | | 90 PERCENTILE | | | PEAK 5 MINUTES | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MIN | MAX | AVG | MIN | MAX | AV | MIN | MAX | AVG | MIN | MAX | AVG | MIN | MAX | AVG |
| 24 | 31 | 26 | 35 | 41 | 37 | 23 | 30 | 76 | 42 | 51 | 46 | 50 | 76 | 68 |

FIGURE 18

FIGURE 19




OCCUPANCY VS TIME

PART 2.—STUDY OF THE RELATIONSHIP BETWEEN SPECTRUM UTILIZATION AND MOBILE LOADING FOR THE 470 MHz BUSINESS SERVICE IN CHICAGO

*Abstract*

A group of 470 MHz Business Radio Service frequencies in Chicago has been studied to determine the degree of statistical correlation between the number of mobile units licensed to a channel and the level of channel utilization. Linear correlation-regression analysis has been applied to spectrum occupancy and mobile loading data gathered at the Commission's Chicago Regional Office. Extremely low coefficients of dependence, on the order of 2%, indicate the occupancy and the number of licensed mobile units are not linearly related. Moreover, no mathematical relationship could be found from which to predict channel occupancy levels from the Commission's mobile loading records. Independent investigations conducted by the Office of Chief Engineer have corroborated the findings of this study.

*Introduction and Background*

In Dockets 18261 and 18262, the Federal Communications Commission adopted mobile loading standards as the basis for determining channel loading for land mobile operations in the 470–512 MHz and 800 MHz bands. For each radio service or group of services governed by Parts 89, 91, and 93 of the Commission's Rules, specific standards for the number of mobile units on a channel were established to determine when that channel could no longer be assigned in a given area. These standards were viewed with considerable uncertainty by the land mobile community. In the Docket 18261 proceeding, a number of parties commented that these standards, as the sole means of determining channel loading, would prove overly rigid. They felt that the operational and technical requirements of land mobile users should also have a role in determining when a channel was fully loaded or when more channels were needed in a communication system.

The loading standards were intended to foster efficient use of the spectrum by preventing the intolerable congestion that had been reported in other land mobile frequency bands. A major concern, however, was the degree to which the number of authorized mobile units would accurately reflect the amount of channel utilization. The Commission's mobile loading records are based upon the information supplied by an applicant in his license application. The loading standards, by nature, might serve to encourage applicants to overstate the number of units in their systems in order to justify additional channels or to minimize channel sharing with other users. (The extent to which this practice has undermined the accuracy of the Commission's records is unknown, but believed sizeable.) Moreover, it is unlikely that all mobile units in a system would be in an operational status at any given time.

These concerns led some parties in the Docket 18261 proceedings to suggest spectrum monitoring as a more objective basis for determining channel loading. At that time, however, the Commission's spectrum monitoring program was in an early stage of development, and mobile loading was the only manageable loading technique available. Moreover, in the absence of documentation to the contrary, a direct relationship between channel utilization and the number of contributing mobile units could logically be assumed.

When the Spectrum Management Task Force initiated the "long-term monitoring project", adequate data for a study of this relationship became available. This type of monitoring provided the best possible depiction of channel utilization for much of the Chicago Metropolitan area. A complete description of the "long-term monitoring project" is given on page 1–3 of Appendix B.

*Study Formulation*

A group of 22 Business Radio Service channels in Chicago were selected for the study for the following reasons:

(1) The channels are governed by mobile loading standards.

(2) Of all 470 MHz pools, only the Business Service pool provided a sufficient number of "on-the-air" channels to permit statistical analysis. In the Public Safety pools, for example, only five of the 26 assignd channels registered occupancy at the Chicago Regional Office during the week of special monitoring for this study.

(3) All users of these business channels operated through mobile relay stations located on downtown Chicago skyscrapers. Since these stations are within "line-of-sight" of the regional office (at Park Ridge, Illinois, 15 miles northwest of the Chicago loop), reception of practically all base and mobile messages could be achieved.

(4) The mobile units on these channels had been licensed at least eight months prior to the week of the monitoring period (January 26–31, 1976). This is significant since the Commission's Rules allow a licensee a period of eight months following the issuance of his license in which to place his system in complete operation.

The 22 channels were monitored at the Chicago Regional Office throughout the week of January 26–30, 1976. This monitoring was done on a nearly continuous basis over the following time periods:
January 26 and 27—6 a.m. to 8 p.m.
January 28 and 29—6 a.m. to 6 p.m.
January 30—1 p.m. to 6 p.m.

*Analysis of Occupancy and Mobile Loading Data*

Table 1, on page 2–7, contains the channel occupancy and mobile loading data analyzed in the study. The occupancy parameters of interest are weekly averages of "daily peak hour", "daily average hour", and "daily 90th percentile" occupancies. These parameters are defined in Appendix B, page 1–5. As an illustration, the weekly "peak hour" occupancy is the arithmetic mean of the daily "peak hour" occupancies for the five days of monitoring.

The mobile loading data in Table 1 consists of the "Total" and "Effective" numbers of mobile units licensed on a channel, the number of licensees sharing the channel, and the number of transmitter sites in operation. The "Total" number of units is the combined number of vehicular and portable radios stated by an applicant on his application form. This is converted to an "Effective" number (for loading determination) by counting each handheld portable as a fraction of a loading unit (one-third of a unit for the Business Service) and then dividing by the number of channels serving the mobile units. Table 1 shows that for the selected frequencies, the "Total" and "Effective" numbers of mobile units were essentially the same.

Presented below is a statistical summary of the data given in Table 1.

*Appendix B*

| Parameter | Mean | Standard deviation | Coefficient of variation [1] | Minimum | Maximum |
|---|---|---|---|---|---|
| Peak hour occupancy | [2] 36 | 11.4 | .317 | [2] 15 | [2] 61 |
| Average hour occupancy | [2] 21 | 7.6 | .362 | [2] 8 | [2] 37 |
| 90th percentile | [2] 46 | 12.6 | .274 | [2] 21 | [2] 66 |
| Total number of mobile units | 80 | 17.9 | .224 | 43 | 115 |
| Effective number of mobiles | 79 | 17.6 | .223 | 42 | 112 |
| Number of users | 6 | 3.5 | .583 | 1 | 15 |

[1] The coefficient of variation is defined as the standard deviation divided by the mean value. It is used to compare the relative variability of parameters having different means.
[2] In percent.

Several observations can be made from the above summary. First, it can be seen that the occupancy levels of the 22 frequencies were not uniformally distributed (see also Figure 1 on page 2–8). The coefficients of the variations (27%–36%) indicate a fairly wide range of variation among the channels. The number of mobile units also varied from channel to channel, but was relatively more stable than the occupancy parameters.

As shown below, more than half of the channels were either above or close to the 90 unit loading limit of the Business Service.

| Effective number of mobiles: | *Number of channels* |
|---|---|
| More than 85 | 11 |
| 75–84 | 4 |
| 65–74 | 3 |
| Less than 65 | 4 |

Although the mobile loading of these channels is generally high, there appears to be space available for prospective users with relatively few mobile units. In terms of channel utilization, however, the loading situation is somewhat different. For instance, the least loaded channel, 472.6625/475.6625 MHz, was licensed 42 mobile units (Table 1). Another 48 units could be licensed before this channel would be at the loading limit. However, the 90th percentile occupancy for this channel was 56%; making it one of the most heavily utilized during the week of the monitoring. In contrast, 472.3375/475.3375 MHz had the lowest 90th percentile occupancy for the week (21%). Yet, this channel was loaded to 89 mobile units, and thus was not assignable. Inspection of Table 1 will reveal similar disparities between utilization and mobile loading.

The line chart in Figure 1 (page 2–8) shows that channel occupancy and the number of mobile units per channel do not generally move in the same direction. This indicates a lack of correlation between these parameters.

*Results of Correlation-Regression Analysis*

"Simple linear correlation-regression analysis" was applied to the occupancy and mobile loading data to determine the degree of linear correspondence between them. The analysis entailed the calculation of correlation and dependence coefficients and the preparation of graphs to aid in visualizing mathematical trends.

Independent analyses were made for six combinations of occupancy and mobile loading parameters. The number of mobile units per channel was taken to be the known variable (independent variable), while the measured level of channel utilization served as

the variable to be predicted (dependent variable). The hypothesis to be tested was that the occupancy and loading variables were matematically related by a linear equation; i.e., a straight line relationship. A high coefficient of correlation would indicate a strong linear relationship, where as a correlation coefficient of zero would suggest that the variables are statistically independent.

The results of the analysis are given below.

| Predicted variable | Known variable | Correlation coefficient | Dependence [1] coefficient (in percent) |
|---|---|---|---|
| Peak hour occupancy | Total number mobiles | +.144 | 2.1 |
| | Effective number mobiles | +.106 | 1.1 |
| Average hour occupancy | Total number mobiles | +.122 | 1.7 |
| | Effective number mobiles | +.098 | 1.0 |
| 90th percentile occupancy | Total number mobiles | +.076 | .6 |
| | Effective number mobiles | +.038 | .1 |

[1] The coefficient of linear dependence is a statistical measure of the extent to which variations in the predicted variable can be attributed to corresponding variations in the known variable. It is found by squaring the value of the coefficient of correlation and multiplying by 100 to express as a percentage.

The extremely low values of these coefficients indicate that a linear equation cannot be used to relate the occupancy and mobile loading variables. This point is further illustrated for the case of the "Peak Hour Occupancy" versus the "Total Number of Mobile Units". Here, a dependence coefficient of 2% implies that 98% of the variations in occupancy cannot be explained by corresponding variations in the number of mobile units.

The relationship between variables is shown graphically in Figure 2 on page 2-9. Each point on the graph represents one of the 22 Business Service channels. The channel points are located by peak hour occupancy on the vertical axis and the total number of licensed mobile units on the horizontal axis. The points are widely scattered and do not appear to cluster around any known mathematical relationship. Linear regression analysis has been used to fit a straight line through the points in such a manner that differences between the observed and predicted values of occupancy will be minimized. If there had been a high coefficient of correlation in a linear sense, the points on the graph would have clustered closely around this line.

The amount of dispersion of the points about the line of best fit is measured by the "standard error of estimate". Expressed in units of the predicted variable (occupancy), the standard error of estimate for the points in Figure 2 is 11.6%. Fifteen of the twenty-two channels had measured occupancy values falling within 11.6% of the predicted values. This dispersion is quite large and again illustrates the lack of a definitive linear relationship between occupancy and mobile loading data.

*Multiple Correlation Analysis*

A "multiple" correlation coefficient was calculated to determine whether improved occupancy predictions could be made when the number of licensees per channel was added as a second independent variable. The calculated value of +.122 indicated no improvement would result.

*Conclusions*

In a strict statistical sense, the following conclusions are applicable only to the 22 Business channels investigated in the study. They cannot be used to make nationwide projections but may provide a clue to the relationship between mobile loading and spectrum utilization in other cities.

(1) The extent of channel utilization cannot be predicted from the Commission's mobile loading records; i.e., from the number of licensed mobile units and/or users. This is not to say that channel occupancy and the actual number of mobiles in operation at a given time are unrelated. The lack of a definitive relationship may more likely be attributed to disparities between the Commission's loading records (as supplied by applicants) and the number of mobile units in actual operation. A second factor which may work contrary to a definitive relation is the highly diverse nature of communications within the Business Radio Service. Further studies need to be made for other radio services and geographic areas before any general conclusions can be stated.

(2) In the metropolitan Chicago area, it appears that additional users could be accommodated on channels which are "fully loaded" according to the present loading standards. Conversely, relatively lightly loaded channels are among the most heavily utilized. The study thus suggests that a frequency assignment system based solely on mobile loading can yield misleading recommendations.

TABLE 1

Channel 14 Business Service Frequencies, by Occupancy, Number of Mobile Units, Number of Users and Number of Transmitter Sites, Chicago, Illinois, January 1976

| No. | Frequency | Occupancy | | | No. Mobile Units* | | No. Users | No. Xmitter Sites** |
|---|---|---|---|---|---|---|---|---|
| | | Avg. Hr | Peak Hr | 90th % | Actual | Effective | | |
| | Mean | 21 | 36 | 46 | 80 | 79 | 6 | --- |
| 1. | 471.8125 | 15 | 29 | 39 | 85 | 85 | 1 | 1 |
| 2. | 471.8375 | 30 | 50 | 61 | 95 | 85 | 8 | 1 |
| 3. | 471.8625 | 22 | 40 | 47 | 93 | 90 | 7 | 2 |
| 4. | 471.8875 | 25 | 41 | 51 | 65 | 65 | 6 | 1 |
| 5. | 471.9125 | 8 | 16 | 24 | 89 | 89 | 2 | 2 |
| 6. | 471.9375 | 26 | 44 | 56 | 67 | 65 | 7 | 2 |
| 7. | 472.0125 | 24 | 40 | 53 | 90 | 90 | 11 | 1 |
| 8. | 472.0375 | 16 | 28 | 38 | 86 | 86 | 7 | 1 |
| 9. | 472.0625 | 22 | 35 | 49 | 76 | 76 | 9 | 2 |
| 10. | 472.0875 | 19 | 36 | 46 | 79 | 79 | 9 | 1 |
| 11. | 472.1125 | 23 | 33 | 43 | 93 | 93 | 8 | 2 |
| 12. | 472.1375 | 37 | 61 | 66 | 112 | 112 | 1 | 1 |
| 13. | 472.1625 | 25 | 44 | 56 | 79 | 79 | 8 | 1 |
| 14. | 472.1875 | 15 | 29 | 40 | 86 | 86 | 15 | 2 |
| 15. | 472.2125 | 23 | 40 | 48 | 54 | 54 | 4 | 1 |
| 16. | 472.2375 | 32 | 51 | 66 | 66 | 66 | 7 | 1 |
| 17. | 472.2875 | 15 | 28 | 38 | 60 | 57 | 8 | 1 |
| 18. | 472.3375 | 9 | 15 | 21 | 89 | 89 | 2 | 2 |
| 19. | 472.6375 | 11 | 25 | 30 | 59 | 59 | 5 | 2 |
| 20. | 472.7625 | 11 | 22 | 30 | 73 | 73 | 8 | 1 |
| 21. | 472.9625 | 24 | 44 | 55 | 115 | 112 | 1 | 1 |
| 22. | 472.6625 | 26 | 42 | 56 | 43 | 42 | 5 | 2 |

* The Actual number of units (Vehicular + Portable) treats a portable as one unit. The Effective number of units counts each handheld portable as one-third unit.

** Actually, all except one user reflected above operates through a mobile relay station located on one of five skyscrapers in the Chicago loop; thus guarenteeing complete reception at the Chicago Regional Office.

Source: Chicago Regional Office Licensing Section records; Monitoring tape no. 0094

FIGURE 1--Line Chart: Peak Hour Occupancy and Total No. Mobile Units Per Frequency Pair, Business Radio Service, Chicago, January 1976 *

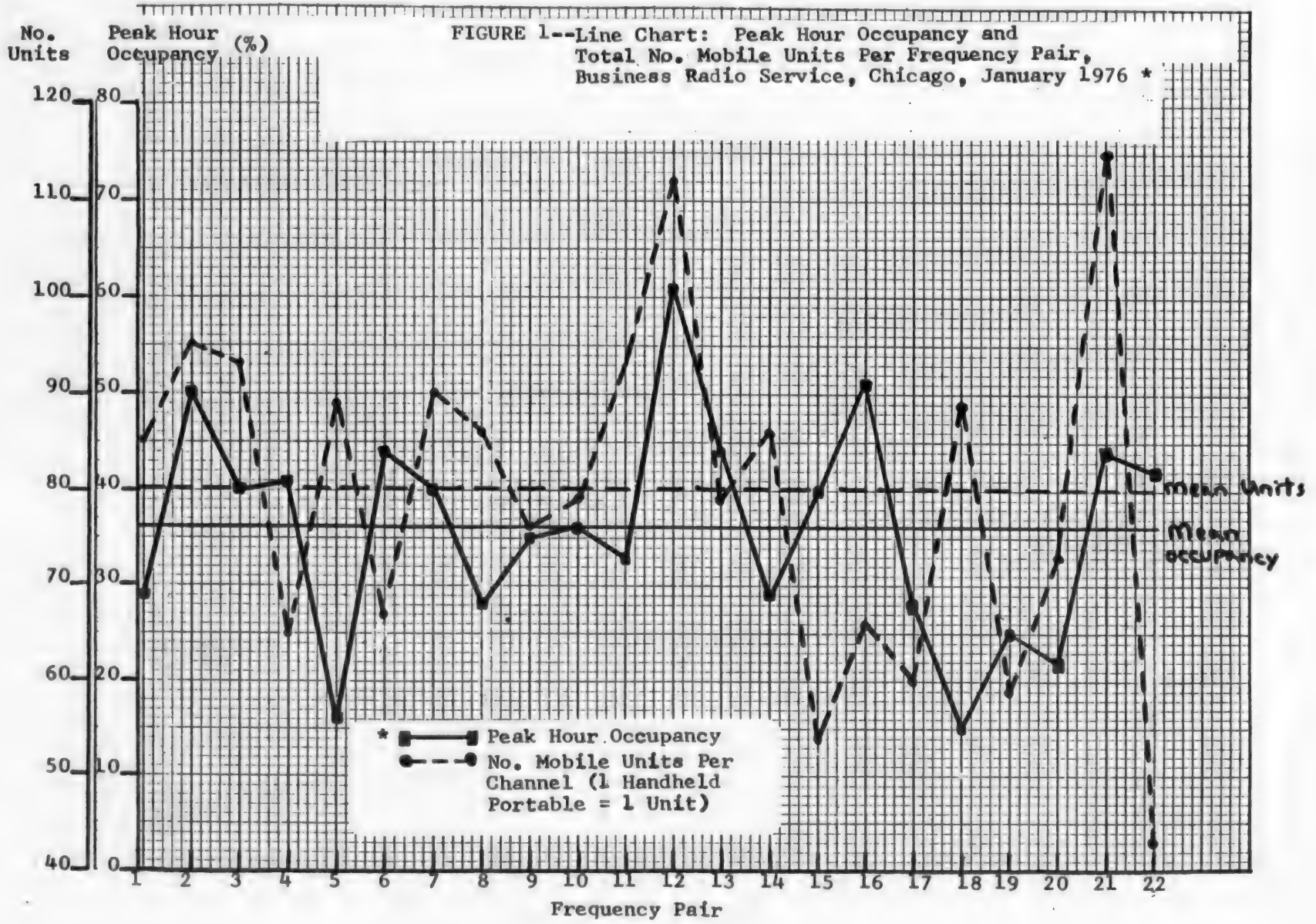
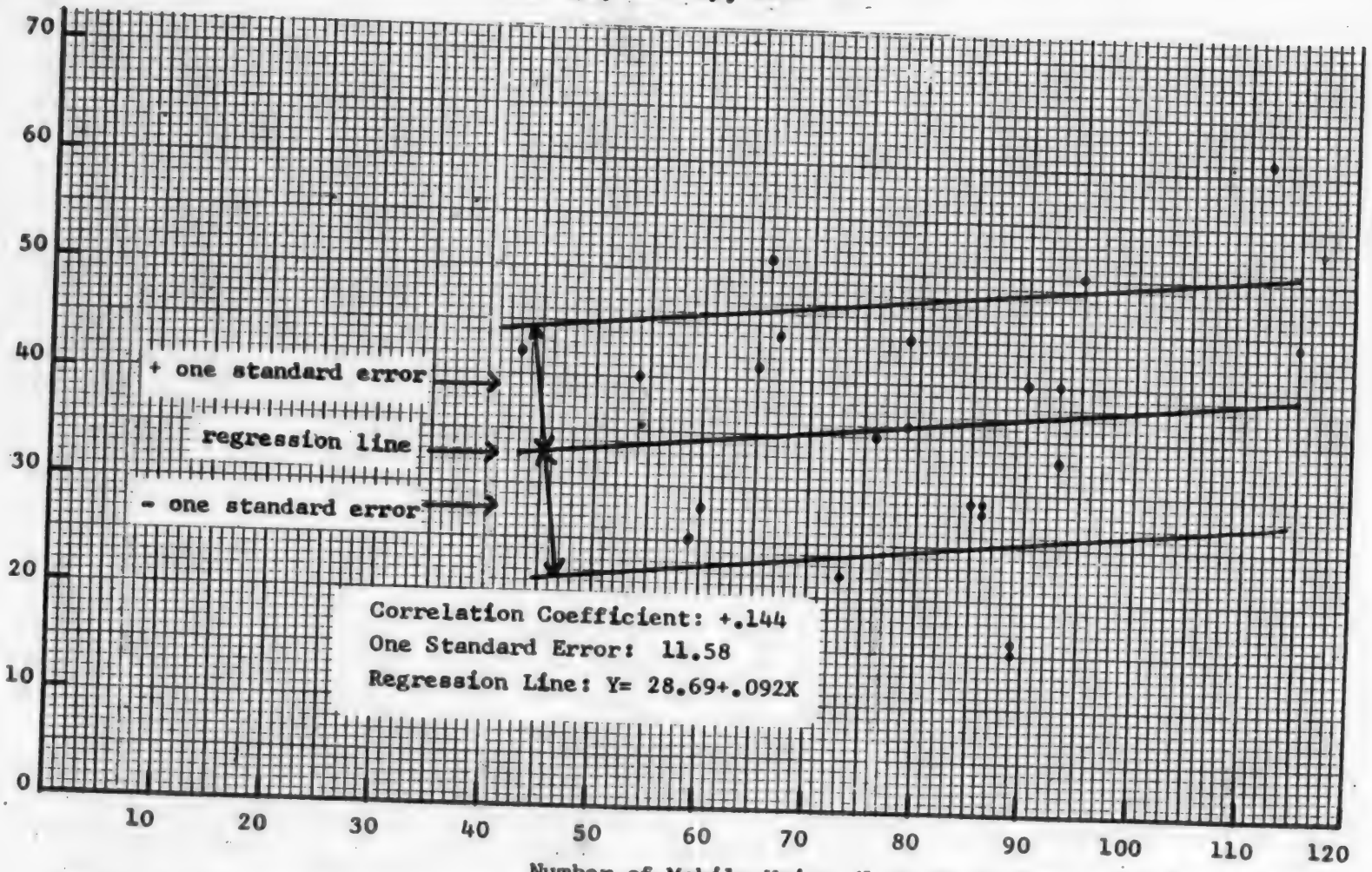


FIGURE 2--Scattergram: Peak Hour Occupancy and No. Mobile Units Per Channel, Business Radio Service, Chicago, January, 1976




Source: Chicago Regional Office, January 26-30, 1976
Tape No. 0094

## APPENDIX C

### PRINTOUTS OF PRODUCTION MONITORING DATA FILES

FREQUENCY RANGE: 470.0000 TO 476.0000 MHZ
FREQUENCIES FOUND WITHIN RANGE: 285
MONITORING DATA SELECTED AROUND: 41.874 DEGREES LATITUDE AND 87.638 DEGREES LONGITUDE
THE MONITORING SITE IS: 22STPD DISTANCE TO MONITORING SITE IS: 1.5 MI
THE SEASONAL PERIODS WERE FROM MONTHS 1 TO 12

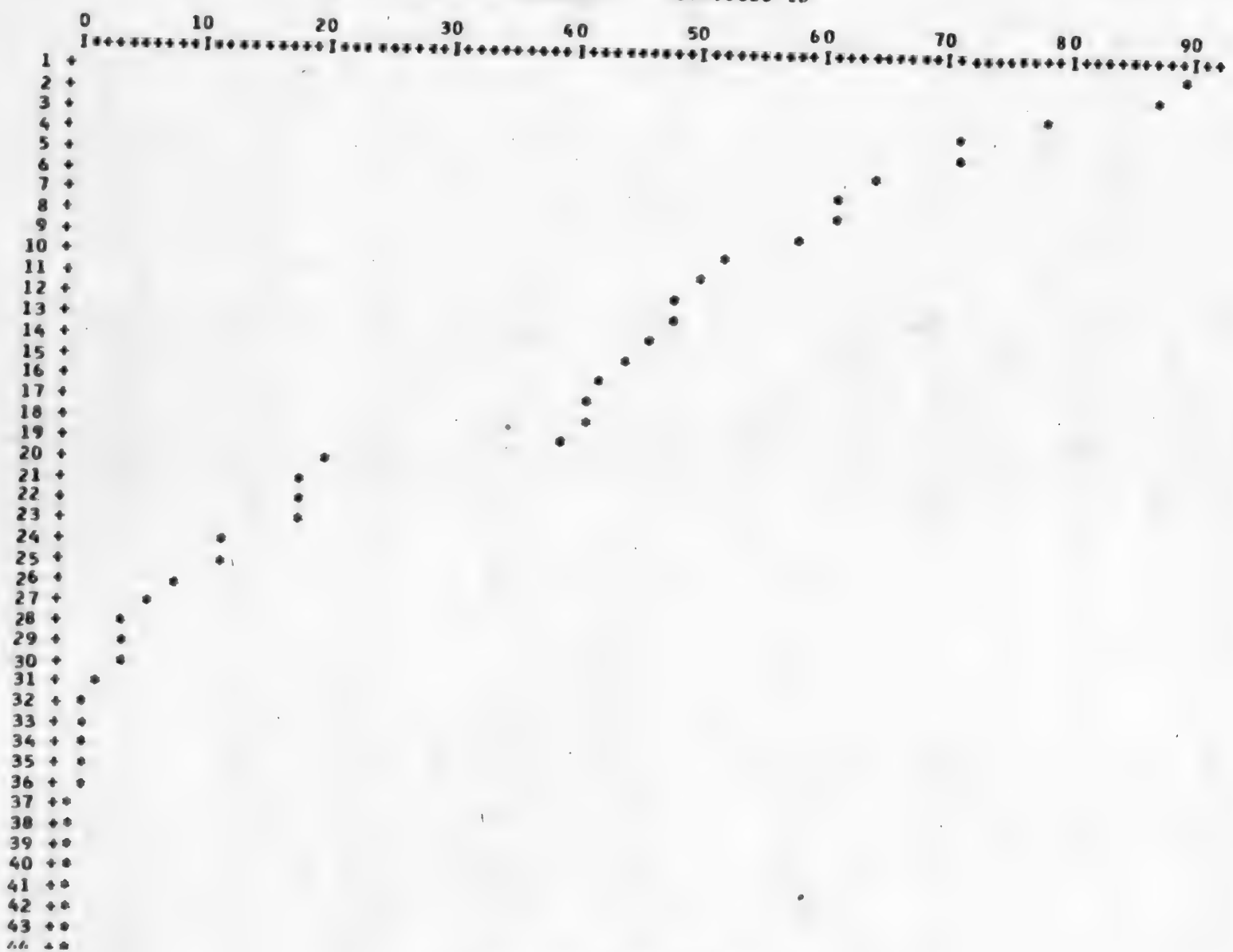
| FREQUENCY (MHZ) | OCCUPANCY ABOVE THRESHOLD | WAITING TIME (SECONDS) | AVERAGE OCCUPANCY ABOVE THRESHOLD | NUMBER OF SAMPLES | DATES MONITORED |
|---|---|---|---|---|---|
| 471.0625 | .00 | .0 | .00 | 9 | 1 73 2 75 3 75 4 76 |
| 471.0875 | .00 | .0 | .00 | 9 | 1 73 2 75 3 75 4 76 |
| 471.1125 | .00 | .0 | .00 | 9 | 1 73 2 75 3 75 4 76 |
| 471.1375 | .00 | .0 | .00 | 9 | 1 73 2 75 3 75 4 76 |
| 471.3125 | .00 | .0 | .00 | 9 | 1 73 2 75 3 75 4 76 |
| 471.3375 | .00 | .0 | .00 | 9 | 1 73 2 75 3 75 4 76 |
| 471.3625 | .00 | .0 | .00 | 9 | 1 73 2 75 3 75 4 76 |
| 471.3875 | .00 | .0 | .00 | 9 | 1 73 2 75 3 75 4 76 |
| 471.4125 | .00 | .0 | .00 | 9 | 1 73 2 75 3 75 4 76 |
| 471.4375 | .13 | 3.5 | .06 | 9 | 1 73 2 75 3 75 4 76 |
| 471.4625 | .00 | .0 | .00 | 9 | 1 73 2 75 3 75 4 76 |
| 471.4875 | .16 | 1.5 | .09 | 10 | 1 73 2 75 3 75 4 76 |
| 471.5125 | .00 | .0 | .00 | 9 | 1 73 2 75 3 75 4 76 |
| 471.5375 | .00 | .0 | .00 | 9 | 1 73 2 75 3 75 4 76 |
| 471.5625 | .13 | 3.0 | .07 | 9 | 1 73 2 75 3 75 4 76 |
| 471.5875 | .42 | 19.5 | .15 | 9 | 1 73 2 75 3 75 4 76 |
| 471.6125 | .47 | 45.5 | .10 | 12 | 1 73 2 75 3 75 4 76 |
| 471.6375 | .47 | 85.5 | .14 | 12 | 1 73 2 75 3 75 4 76 |
| 471.8125 | .43 | 27.0 | .06 | 12 | 1 73 2 75 3 75 4 76 |
| 471.8375 | .70 | 500.0 | .19 | 12 | 1 73 2 75 3 75 4 76 |
| 471.8625 | .65 | 500.0 | .15 | 10 | 1 73 2 75 3 75 4 76 |
| 471.8875 | .44 | 35.5 | .11 | 12 | 1 73 2 75 3 75 4 76 |
| 471.9125 | .23 | 2.0 | .05 | 10 | 1 73 2 75 3 75 4 76 |
| 471.9375 | .71 | 500.0 | .18 | 12 | 1 73 2 75 3 75 4 76 |
| 471.9625 | .44 | 29.0 | .13 | 10 | 1 73 2 75 3 75 4 76 |
| 471.9875 | .44 | 49.0 | .10 | 10 | 1 73 2 75 3 75 4 76 |
| 472.0125 | .58 | 132.5 | .17 | 9 | 1 73 2 75 3 75 4 76 |
| 472.0375 | .44 | 29.5 | .12 | 9 | 1 73 2 75 3 75 4 76 |
| 472.0625 | .35 | 2.5 | .09 | 10 | 1 73 2 75 3 75 4 76 |
| 472.0875 | .51 | 87.0 | .14 | 9 | 1 73 2 75 3 75 4 76 |
| 472.1125 | .73 | 500.0 | .21 | 10 | 1 73 2 75 3 75 4 76 |
| 472.1375 | .79 | 500.0 | .30 | 10 | 1 73 2 75 3 75 4 76 |
| 472.1625 | .56 | 188.5 | .13 | 12 | 1 73 2 75 3 75 4 76 |

```
FREQUENCY LIST WILL BE SEARCHED FOR
   0 CATEGORIES
   0 GROUPINGS WITHIN CATEGORY
   1 SERVICES
   0 CLASSES OF STATIONS
   1 BANDS
SERVICES SEARCHED IB
BANDS SEARCHED C14
BOTH (B) EXCLUSIVE OR NON-EXCLUSIVE FREQUENCIES SELECTED
PARTICULARS OF OPERATION:


   44 FREQUENCIES SELECTED - THEY ARE:
 471.8125  471.8375  471.8625  471.8875  471.9125  471.9375  471.9625
 471.9875  472.0125  472.0375  472.0625  472.0875  472.1125  472.1375
 472.1625  472.1875  472.2125  472.2375  472.2625  472.2875  472.3125
 472.3375  474.8125  474.8375  474.8625  474.8875  474.9125  474.9375
 474.9625  474.9875  475.0125  475.0375  475.0625  475.0875  475.1125
 475.1375  475.1625  475.1875  475.2125  475.2375  475.2625  475.2875
 475.3125  475.3375

MONITORING DATA
  41.855= LAT  87.627= LONG           10= MI 12 M2
 THE NEAREST MONITORING SITE 22STPO IS     .0 MILES FROM THE ABOVE LOCATION.
```

| FREQUENCY | OCCUPANCY | AVE OCC | WAIT TIME | SAMPLES | DATES MONITORED | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 474.8125 | .00 | .00 | .0 | 10 | 4 | 74 | ** | ** | ** | ** | ** | ** |
| 474.9375 | .00 | .00 | .0 | 10 | 4 | 74 | ** | ** | ** | ** | ** | ** |
| 475.0375 | .00 | .00 | .0 | 10 | 4 | 74 | ** | ** | ** | ** | ** | ** |
| 475.0625 | .00 | .00 | .0 | 10 | 4 | 74 | ** | ** | ** | ** | ** | ** |
| 475.0875 | .00 | .00 | .0 | 10 | 4 | 74 | ** | ** | ** | ** | ** | ** |
| 475.1625 | .00 | .00 | .0 | 10 | 4 | 74 | ** | ** | ** | ** | ** | ** |
| 475.2625 | .00 | .00 | .0 | 10 | 4 | 74 | ** | ** | ** | ** | ** | ** |
| 475.3375 | .00 | .00 | .0 | 10 | 4 | 74 | ** | ** | ** | ** | ** | ** |
| 474.9125 | .01 | .00 | .0 | 10 | 4 | 74 | ** | ** | ** | ** | ** | ** |
| 474.9875 | .01 | .00 | .0 | 10 | 4 | 74 | ** | ** | ** | ** | ** | ** |
| 475.1875 | .01 | .00 | .0 | 10 | 4 | 74 | ** | ** | ** | ** | ** | ** |
| 475.2875 | .01 | .00 | .0 | 10 | 4 | 74 | ** | ** | ** | ** | ** | ** |
| 475.3125 | .01 | .00 | .0 | 10 | 4 | 74 | ** | ** | ** | ** | ** | ** |
| 475.1125 | .02 | .01 | .0 | 10 | 4 | 74 | ** | ** | ** | ** | ** | ** |
| 475.0125 | .04 | .01 | .0 | 10 | 4 | 74 | ** | ** | ** | ** | ** | ** |
| 475.2375 | .04 | .01 | .5 | 10 | 4 | 74 | ** | ** | ** | ** | ** | ** |
| 474.8375 | .05 | .01 | .5 | 10 | 4 | 74 | ** | ** | ** | ** | ** | ** |
| 474.8625 | .07 | .01 | .5 | 10 | 4 | 74 | ** | ** | ** | ** | ** | ** |
| 474.9625 | .09 | .01 | 1.0 | 10 | 4 | 74 | ** | ** | ** | ** | ** | ** |
| 472.0625 | .12 | .03 | 2.5 | 11 | 4 | 74 | ** | ** | ** | ** | ** | ** |
| 474.8875 | .13 | .02 | 1.0 | 10 | 4 | 74 | ** | ** | ** | ** | ** | ** |
| 472.2625 | .19 | .07 | 2.5 | 11 | 4 | 74 | ** | ** | ** | ** | ** | ** |
| 472.3375 | .19 | .04 | 7.0 | 11 | 4 | 74 | ** | ** | ** | ** | ** | ** |
| 475.1375 | .19 | .05 | 4.5 | 10 | 4 | 74 | ** | ** | ** | ** | ** | ** |
| 475.2125 | .21 | .03 | 6.0 | 10 | 4 | 74 | ** | ** | ** | ** | ** | ** |
| 472.2875 | .40 | .07 | 10.0 | 11 | 4 | 74 | ** | ** | ** | ** | ** | ** |
| 472.1125 | .41 | .08 | 22.0 | 11 | 4 | 74 | ** | ** | ** | ** | ** | ** |
| 472.3125 | .42 | .08 | 25.0 | 11 | 4 | 74 | ** | ** | ** | ** | ** | ** |
| 472.1875 | .43 | .11 | 21.5 | 11 | 4 | 74 | ** | ** | ** | ** | ** | ** |
| 472.1625 | .45 | .07 | 72.5 | 11 | 4 | 74 | ** | ** | ** | ** | ** | ** |
| 471.8125 | .47 | .07 | 43.0 | 11 | 4 | 74 | ** | ** | ** | ** | ** | ** |
| 472.0875 | .49 | .06 | 46.0 | 11 | 4 | 74 | ** | ** | ** | ** | ** | ** |
| 472.2125 | .49 | .08 | 119.0 | 11 | 4 | 74 | ** | ** | ** | ** | ** | ** |
| 471.9125 | .50 | .08 | 11.5 | 11 | 4 | 74 | ** | ** | ** | ** | ** | ** |
| 471.8875 | .53 | .07 | 62.0 | 11 | 4 | 74 | ** | ** | ** | ** | ** | ** |
| 472.0375 | .59 | .07 | 176.5 | 11 | 4 | 74 | ** | ** | ** | ** | ** | ** |
| 471.9625 | .62 | .13 | 500.0 | 11 | 4 | 74 | ** | ** | ** | ** | ** | ** |
| 471.9875 | .62 | .08 | 183.5 | 11 | 4 | 74 | ** | ** | ** | ** | ** | ** |
| 471.8375 | .64 | .14 | 283.0 | 11 | 4 | 74 | ** | ** | ** | ** | ** | ** |
| 471.8625 | .72 | .16 | 500.0 | 11 | 4 | 74 | ** | ** | ** | ** | ** | ** |
| 471.9375 | .72 | .12 | 500.0 | 11 | 4 | 74 | ** | ** | ** | ** | ** | ** |
| 472.1375 | .79 | .21 | 500.0 | 11 | 4 | 74 | ** | ** | ** | ** | ** | ** |
| 472.2375 | .88 | .14 | 500.0 | 11 | 4 | 74 | ** | ** | ** | ** | ** | ** |
| 472.0125 | .89 | .19 | 500.0 | 11 | 4 | 74 | ** | ** | ** | ** | ** | ** |


OCCUPANCY 44 CHANNELS, SERVICES IB
0
10
20
30
40
50
60
70
80
90
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43

FCC FREQUENCY RECOMMENDATION
CHICAGO REIGONAL OFFICE

**********

NOT A LICENSE TO OPERATE. SELECT ONE RECOMMENDATION
SIGN AND RETURN PRIOR TO EXPIRATION DAT.

**********

APPLICATION NO: CIS750135064 ISSUE DATE: JAN. 15, 1975
TYPE OF SYSTEM: BASE AND MOBILE EXPIRATION DATE: FEB. 15, 1975

RECOMMENDATION NO: 1 BASE: 151.3250 MHZ MOBILE: 151.9250 MHZ

BASE STATION: 41-58-23 N
87-40-16 N
MOBILE OPERATING AREA:
4 5Y 4 MILES

RECOMMENDED SYSTEM:
ANTENNA HEIGHT AS: 10 FT
EFFECTIVE RADIATED POWER: 18.0 WATTS
TONE-CONTROLLED SQUELCH FREQUENCY: 203.5 HZ

SELECTION CRITERIA:
LEVEL OF SERVICE: 36%
LEVEL OF OCCUPANCY: 63%
WAITING TIME: 161.5 SECONDS

JAMES P. PETERSON AGENCY
3414 N. AVERS
CHICAGO, ILLINOIS 60618

SIGNATURE _____ TITLE _____ DATE _____

THERE ARE 13 CO-CHANNEL USERS WITHIN 20.0 MILES OF THE TRANSMITTER
1 MARLIS CONSTRUCTION COMPANY

2 HAROLD J. NEVILLS D/B/A
J-P TOWING
3 INLAND STEEL COMPANY

4 CONNEY's PHARMACY

5 VAN RYN SCAVENGER, INC.

6 LOEW'S CHICAGO HOTEL CORP.

7 SIEVERT ELECTRIC CO.

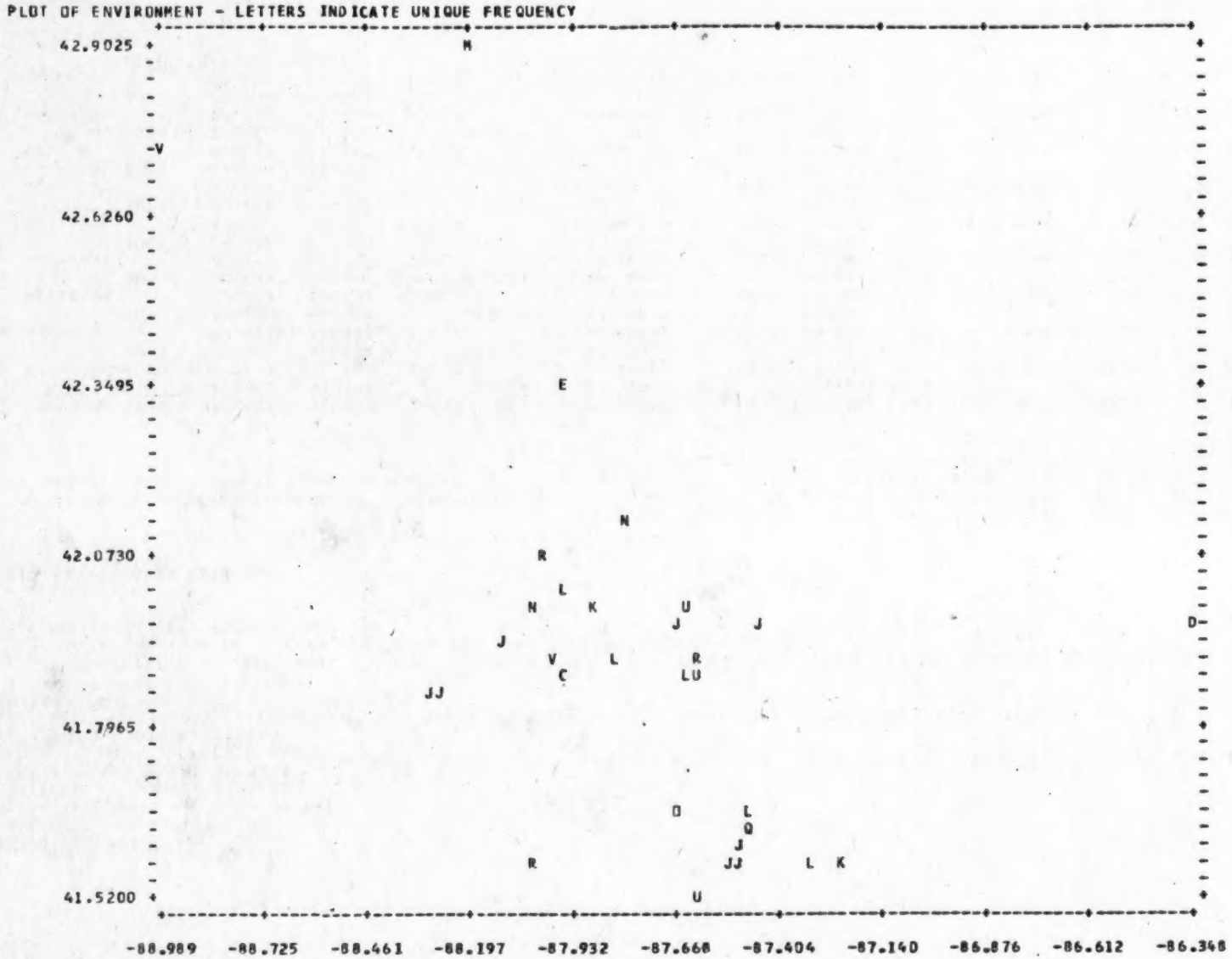
INPUT PARAMETERS
FREQUENCY = 461.91250 MHZ
DELTA FREQUENCY = .27500 MHZ
LATITUDE = 41.880 DEGREES
LONGITUDE = 87.600 DEGREES
DELTA DISTANCE = 100.0 MILES
TX TYPE RECORDS RETRIEVED
TIME USED SINCE LAST CALL TO CLOCK: 7.111 SECONDS CPU TIME -58508.248 SECONDS WALL CLOCK TIME

FOR DELTAF = .2750 MHZ, FREQ = 461.9125 MHZ, LT = 41.880 DEG, LN = 87.600 DEG, AND DELTAD = 100.0 MI
THERE WERE 126 TX 0 RX 61 TSC, AND 0 MO TYPE RECORDS STORED
957 ACCESS(ES) TO DATA BASE

187 RECORDS GATHERED

| FREQUENCY (MHZ) | TYPE | LONGITUDE (DEGS) | LATITUDE (DEGS) | POWER (WATTS) | CLASS | LICENSE NO | LICENSEE ID | CALL SIGN | ANT HT (FT) | GRD ELEV (FT) | EST SIGNAL LEVEL (DB) | OCCUP LEVEL (%) | NUM MOB | TONE SQULCH FREQ (HZ) | ANT GAIN (DB) | AZIM (DEGS) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 461.6500 | TX | 87.613 | 41.892 | 150.0 | FB2 | CIB731380029 | 9090 | KUA696 | 665 | 592 | -138.0 | 885.0 | 0 | 141.3 | 6.0 | 360 |
| | ADP: | 87.846 | 41.908 | | S1/S2: | 40.0/ 80.0 | | ORIEN: | 50.0 | | | | | | | |
| 461.6500 | TS | 87.613 | 41.892 | 150.0 | FB2 | CIB732390886 | 14388 | KTF321 | 665 | 592 | -138.0 | ***** | 0 | .0 | 6.0 | 360 |
| | ADP: | 87.613 | 41.892 | | S1/S2: | 80.0/ 80.0 | | ORIEN: | 90.0 | | | | | | | |
| 461.6500 | | 87.613 | 41.892 | 150.0 | | CIB732390971 | 13996 | KUJ254 | 665 | 592 | -138.0 | .0 | 0 | .0 | 6.0 | 360 |
| | ADP: | 87.846 | 41.908 | | S1/S2: | 40.0/ 80.0 | | ORIEN: | 50.0 | | | | | | | |
| 461.6500 | | 87.613 | 41.892 | 150.0 | | CIB732391509 | 10993 | KTG260 | 665 | 592 | -138.0 | .0 | 0 | 136.5 | 6.0 | 360 |
| | ADP: | 87.846 | 41.908 | | S1/S2: | 40.0/ 80.0 | | ORIEN: | 50.0 | | | | | | | |
| 461.6500 | | 87.613 | 41.892 | 150.0 | | CIB732391625 | 9515 | KGM397 | 665 | 592 | -138.0 | .0 | 0 | 186.2 | 6.0 | 360 |
| | ADP: | 87.846 | 41.908 | | S1/S2: | 40.0/ 80.0 | | ORIEN: | 50.0 | | | | | | | |
| 461.6500 | | 87.613 | 41.892 | 150.0 | | CIB732391723 | 9548 | KSP526 | 665 | 592 | -138.0 | .0 | 0 | 103.5 | 6.0 | 360 |
| | ADP: | 87.846 | 41.908 | | S1/S2: | 40.0/ 80.0 | | ORIEN: | 50.0 | | | | | | | |
| 461.6500 | | 87.613 | 41.892 | 150.0 | | CIB732392454 | 11150 | KFM691 | 665 | 592 | -138.0 | .0 | 0 | 91.5 | 6.0 | 360 |
| | ADP: | 87.846 | 41.908 | | S1/S2: | 40.0/ 80.0 | | ORIEN: | 50.0 | | | | | | | |
| 461.6500 | | 87.613 | 41.892 | 150.0 | | CIB732392492 | 11029 | KUA696 | 665 | 592 | -138.0 | .0 | 0 | 141.3 | 6.0 | 360 |
| | ADP: | 87.846 | 41.908 | | S1/S2: | 40.0/ 80.0 | | ORIEN: | 50.0 | | | | | | | |
| 461.6500 | | 87.613 | 41.892 | 150.0 | | CIB732392540 | 11212 | KSR350 | 665 | 592 | -138.0 | .0 | 0 | 127.3 | 6.0 | 360 |
| | ADP: | 87.846 | 41.908 | | S1/S2: | 40.0/ 80.0 | | ORIEN: | 50.0 | | | | | | | |
| 461.6500 | | 87.613 | 41.892 | 150.0 | | CIB742900017 | 25472 | KWY334 | 665 | 592 | -138.0 | .0 | 0 | .0 | 6.0 | 360 |
| | ADP: | 87.846 | 41.908 | | S1/S2: | 40.0/ 80.0 | | ORIEN: | 50.0 | | | | | | | |

EDR Plot


PLOT OF ENVIRONMENT - LETTERS INDICATE UNIQUE FREQUENCY
42.9025
42.6260
42.3495
42.0730
41.7965
41.5200
-88.989
-88.725
-88.461
-88.197
-87.932
-87.668
-87.404
-87.140
-86.876
-86.612
-86.348

SPECIAL RETRIEVAL/CORRELATION PROGRAM OUTPUT

***** ANALYSIS ON FREQUENCY: 471.8625 MHZ

WITH 6 CO-CHANNEL TRANSMITTERS AND 131 ADJACENT CHANNEL TRANSMITTERS

| THRESHOLD LEVELS | CO-CHANNEL SIGNALS ABOVE THRESHOLD | ADJACENT CHANNEL SIGNALS ABOVE THRESHOLD | CO-CHANNEL ON-CHANNEL MOBILES | CO-CHANNEL ASSOCIATED MOBILES | ADJACENT CHANNEL ON-CHANNEL MOBILES | ADJACENT CHANNEL ASSOCIATED MOBILES |
|---|---|---|---|---|---|---|
| -140.0 | 6 | 1 | 0 | 0 | 0 | 0 |

CO-CHANNEL CALL SIGN/LICENSE :
KUV927 /CIB731500127 KQM450 /CIB731500133 KVK305 /CIB732140008 KUN256 /CIB733320003 KZZ201 /CIB741690026
KWS471 /CIB741890007

ADJACENT CHANNEL CALL SIGN/LICENSE :
KEY622 /CIB731580006

***** ANALYSIS ON FREQUENCY: 471.8875 MHZ

WITH 6 CO-CHANNEL TRANSMITTERS AND 131 ADJACENT CHANNEL TRANSMITTERS

| THRESHOLD LEVELS | CO-CHANNEL SIGNALS ABOVE THRESHOLD | ADJACENT CHANNEL SIGNALS ABOVE THRESHOLD | CO-CHANNEL ON-CHANNEL MOBILES | CO-CHANNEL ASSOCIATED MOBILES | ADJACENT CHANNEL ON-CHANNEL MOBILES | ADJACENT CHANNEL ASSOCIATED MOBILES |
|---|---|---|---|---|---|---|
| -140.0 | 6 | 3 | 0 | 0 | 0 | 0 |

CO-CHANNEL CALL SIGN/LICENSE :
KVU508 /CIB733600002 KVW935 /CIB740320004 KWE721 /CIB740740042 KWH774 /CIB741010009 KSI908 /CIB741210037
KWD769 /CIB741540023

ADJACENT CHANNEL CALL SIGN/LICENSE :
KUV927 /CIB731500127 KQM450 /CIB731500133 KEY622 /CIB731580006

***** ANALYSIS ON FREQUENCY: 471.9125 MHZ

WITH 3 CO-CHANNEL TRANSMITTERS AND 134 ADJACENT CHANNEL TRANSMITTERS

| THRESHOLD LEVELS | CO-CHANNEL SIGNALS ABOVE THRESHOLD | ADJACENT CHANNEL SIGNALS ABOVE THRESHOLD | CO-CHANNEL ON-CHANNEL MOBILES | CO-CHANNEL ASSOCIATED MOBILES | ADJACENT CHANNEL ON-CHANNEL MOBILES | ADJACENT CHANNEL ASSOCIATED MOBILES |
|---|---|---|---|---|---|---|
| -140.0 | 3 | 1 | 0 | 0 | 0 | 0 |

CO-CHANNEL CALL SIGN/LICENSE :
KZZ760 /CIB731500131 KCL391 /CIB750520018 KDV611 /CIB750520021

[FR Doc.77-14296 Filed 5-19-77;8:45 am]